ISSN: 2707-1146
e-ISSN: 2709-4189

Nature & Science

International Scientific Journal

THE REPUBLIC OF AZERBAIJAN

NATURE and SCIENCE

International Online Scientific Journal

Volume: 6 Issue: 7

Baku

2024

The journal is included in the register of Press editions of the Ministry of Justice of the Republic of Azerbaijan on 04.07.2019.
Registration No. 4243

International Indices

ISSN: 2707-1146
e-ISSN: 2709-4189
DOI: 10.36719

Editorial address
AZ1073, Baku,
Matbuat Avenue, 529,
"Azerbaijan" Publishing House,
6-th floor

Tel.: +994 50 209 59 68
+994 55 209 59 68
+994 99 805 67 68
+994 12 510 63 99

e-mail:
nature.science2000@aem.az

MEDICINE AND PHARMACEUTICAL SCIENCES

DOI: https://doi.org/10.36719/2707-1146/46/5-9

Khatira Khalafli
Azerbaijan Medical University
Doctor of philosophy in medicine
khalafli@mail.ru
Maharram Niftullayev
Azerbaijan Medical University
Doctor of Medical Sciences
mniftullayev@gmail.com
Khatira Jafarova
Azerbaijan Medical University
Doctor of philosophy in medicine
khatira.cafarova@mail.ru
Dasta Gasimova
Azerbaijan Medical University
qasimova dasta@gmail.com
Leyla Akhmedzade
Azerbaijan Medical University
Doctor of philosophy in medicine
leyla.akhmedzade@mail.ru

EPIDEMIOLOGICAL FEATURES OF CYTOMEGALOVIRUS INFECTION

Abstract

The article briefed on the epidemiological features of cytomegalovirus infection and shared the successes and experiences of studying these diseases in recent years. Cytomegaly is an infectious disease of viral origin that is fairly common and its manifestations can range from symptomatic forms of internal organs and the central nervous system to severe injuries. The detection of symptoms of cytomegaly in newborns confirms that the fetus is infected inside the uterus. The presence of cytomegalovirus in the mating of an infected newborn proves that infection occurs through the mating. However, the receipt of cytomegaloviruses from the skin and muscle of the embryo excluded through the surgical procedure, and samples made from the lungs and kidneys of the embryo perpetrated on their own, means that the fetus is infected through ciftia in the womb.

***Keywords**: cytomegalovirus, epidemiology, prevention, non-infectious diseases, diagnostics, infectious diseases, epidemiological aspects, epidemiological control*

Introduction

Cytomegalovirus infection – also referred to as cytomegaly, viral disease of saliva glands, occlusion cytomegaly, disease in combination with attachments, SMV “diseases of civilization” - has been widespread around the world over the last decade. Cytomegaly is an infectious disease of viral origin that is fairly common and its manifestations can range from symptomatic forms of internal organs and the central nervous system to severe injuries.

Cytomegaly is a viral disease characterized by damage to the saliva glands and other members, giant cells in their tissues, and large intraocular derivatives. Among the diseases caused by the H erpesviridae family viruses, cytomegalovirus infection is one of the leading places. In most cases, CMV Infectious goes on as symptomatic viruses and occurs only as a clinically manifested disease during primary or secondary immundeficit, indicating that the pathogenesis of the disease plays a leading role in suppressing the immune system function of the infected person (Aghayev, 2022: 414).

ISSN: 2707-1146
e-ISSN: 2709-4189

Research

The cytomegalovirus infection was first described by Ribbert in 1881 at the end of the nineteenth century under the name “kissing disease”, as it was believed that transmission occurs via a kissing spit. The cytomegalovirus, the real "cause" of cytomegaly, was only discovered in 1956. It has been proven that cytomegaly is not only detected through saliva (although the virus is actually often detected in the saliva glands, so one of the names of the disease – the viral disease of the saliva glands - is derived from it) but also through sexual intercourse, transplacental – it is transmitted from a pregnant woman, as well as during close domestic contact. In addition, cases of cytomegalovirus are known during blood transfusion, and transplantation of organs and tissues. Cytomegaloviurs infection is common, but most virus sufferers do not suspect it at all.

A brief history. Cytomegaloviruses are a special group of the herpes virus family, common among many species of humans and mammals. Its patronymic name refers to the “virus of the saliva glands”' finding of neuter cells (cytomegalic cells) in many cases in the saliva glands of children and animals. Humans used to refer to the disease-causing virus as "the cytomegaly contiguous virus," which indicates the etiological connection of a common disease that often results in death in newborns. For a long time, the diagnosis of human cytomegaly was based on histological examination of the collateral. Carrying out diagnostics in live individuals was possible after the use of a technique to detect the cytomegaly virus in children's urine (Rymarenko, 2023: 47). The cultivation of the cytomegaly virus in laboratory conditions made it possible to develop serological methods of diagnosis by detecting acute disease in patients. The widespread use of virological and serological techniques has made it possible to assess their importance in the diagnosis of congenital and postpartum cytomegaly (Megan, 2022: 138).

Propagation. Cytomegaly virus disease is common in many countries. Immunofluorescence is used in diagnosing of this disease in CIS countries and is currently used in many centers.

Etiology Morphologically, the CMV differs from the human herpes disease and smallpox. The electron microscopy examination results show that the virion consists of an icosahedral capsid (110 nm) connecting 162 capsomeres. Some viral particles are surrounded by a single or double membrane. The size of these particles is 180-250 nm. The electron microscope is located at the nucleus of the virus. The genome of the virus is DNA. Unlike the herpes virus (68%), the cytomegaly virus has significantly less content of guanine and cytosine in its DNA (58%). Virus particles contain lipids. Cytomegaloviruses are dispersed due to repeated freezing and melting and are not stored at -50°C without stabilizers.

These viruses produce reflections that are neutralizing and complementary to their effects. The issue of the presence of various cytomegaloviruses is not yet resolved. A human immune envelope is negative against monkey cytomegalovirus antigen. Cytomegaloviruses develop only in homologous cell cultures. The virus reproduces in human-onset fibroblasts. However, they also develop in receding human cell cultures (embryo skin, lungs, calves, uterine muscle layer, Vi-38 diploid cells). It has a cytopathic effect on viral onset and single cell culture (Congenital Cytomegalovirus, 2017: 64).

Pathogenesis and clinic. The incidence of cytomegaly varies depending on the age. Congestive cytomegaly may cause the fetus to die in utero or produce clinical symptoms specific to cytomegaly. Signs are usually detected after the birth of a child and are symptoms of developmental imbalances, jaundiced hepatosplenomegaly, pneumonia, and most commonly damage to the central nervous system (microcephaly, salt accumulation around the cerebral stomachs, chorioretinitis, atrophy of the visual nerve, sensory and movement delays). Previously, it was believed that congenital cytomegaly necessarily results in the death of a child. It was later discovered that children could contract primary illness and live for several years afterwards. Incidents of mild illness also occur. Children who have survived the disease are usually marked by a diminished brain, mobility disorders, and a delay in mental development. Recently, studies have shown that infection with cytomegaloviruses in the womb has led to the emergence of such conditions in most children with small brains and mentally retarded children. There is also information about developing congenital

disease without notice of clinical signs. It was found that in 8 of 507 born urethra, the virus was detected in urine, but only one was detected with intraocular salt accumulation, and the rest were not different from norlmal children (Sentongo, 2021: 57).

Infection with cytomegaloviruses is possible even after birth, but specific clinical signs are less pronounced at this time. Morphological variations specific to cytomegaly are found in the saliva glands of 8-32% of children who died after 3 years of age, which confirms that children are infected after birth. Some researchers report on breast-feeding of the virus (Davis, 2017: 37).

During the serological examination of the population, the positive result increases exponentially as the age increases. 33-75% of newborns' blood can be found in reflections that combine compliments. Over a year, that number drops to 29%, and in people over 35, it rises to 51-81%. It has been found that children infected with cytomegaloviruses develop chronic hepatitis and interstitial pneumonia. It is especially observed after blood transfusion (during operative intervention in the heart, etc.) for these various purposes.

CMV is common everywhere. Individuals with different geographic locations and economic conditions become infected early in life, and the disease often drives clinically symptomatic. Clinical signs of cytomegalovirus infection usually manifest in the form of primary syndromes: perinatal infection of newborns in mothers with primary SMVI during pregnancy; acute acquired SMVI similar to infectious mononucleosis; and CMVI-syndrome in immunompromised individuals (including HIV-infected people). SMV can be a cause of retinopathies, various gastrointestinal infections, diseases of the central nervous system, and most likely sometypes of atherosclerosis. Oral cavity ulcers in immunocompromised individuals can often be associated with SMV. 53% of ulcers in HIV-positive patients are associated with SMV and 28% with mixed SMV and SHV infection. Sometimes these processes may involve the tissues of the tooth and the parodont, which may lead to future bone destruction and the development of osteomyelitis (Concetta Marsico, 2019: 187).

Depending on the age of the perpetrator in the human body, different forms of virus interaction with the possessed organism are distinguished. If the virus remains in the body for a short time, the infectious process can go either in an acute (short incubation period and development of character symptoms) or inapparent (symptomatic) form.

The main stages of SMVI development are: primary infection of the skin and mucous membranes, «colonization» and acute infection of the bloodbeds, and subsequent development of latency – only viral DNA in the nuclei of neurons proves that infection exists. After completion of the acute phase, SMVI sensation is not more obvious in bruises. The mechanism of progression from the acute stage of infection (at this time, the virus cannot be detected in the homogeneities of bruises) to the latent phase has not yet been clarified. This transition is relevant to the emergence of immune factors: the owner's immune response decreases the reproduction of the virus in the skin, disappears the signal, and the cells of the bloodstream become non-permessive, meaning that the latent stage of infection develops.

Detection of SMVI in the bruises of people who have previously had SMVI confirms the reactivation of the infection, which can be symptomatic and develop with damage to the skin and mucous membranes. Disruption of the balance between cells and SMVI under the influence of prevocational factors leads to accelerated replication of the virus, which clinically manifests as an exacerbation of the disease. SMVI reinfection may occur on several occasions, both with limited (mono-infection) and against the background of other infections (midst-infection) (Agayev, 2022: 416).

Prophylaxis and countermeasures. For the specific prophylaxis of cytomegaly, a live vaccine against cytomegalovirus from the Towne strain was developed as a result of repeated passage in Vi-38 human diploid cells. Vaccination with a live vaccine for 8 weeks before transplanting the kidneys of patients with contraindications to patients without contraindications to cytomegaly virus prevents disease. However, transmission through this tool cannot be prevented. Therefore work in the field of vaccine improvement is developed (D'Antonio, 2023: 137).

General preventive measures should be aimed at the timely detection of patients and viruses and the prevention of the spread of disease by modern methods. These measures should first be taken seriously among pregnant women, and mothers and newborns should be examined in their maternity homes.

Laboratory diagnostics. Laboratory diagnostics of cytomegaly are mainly carried out in two directions: a) acquisition of cytomegalovirus; and b) serological examination.

a) Getting viruses in the urine and saliva (oral cavity) is the most reputable and sensitive way to detect the disease. However, still acquiring the virus does not necessarily mean that it is an etiological factor in the disease (other than newborns with symptoms of cytomegaly). In relatively older children, the etiology of the virus is assumed to be of etiological importance in cases of unknown pneumonia, hemolytic anemia, and hemolytic or chronic hepatitis. This also applies for patients with pneumonia, hepatitis, or cytomegaly who are receiving immunodepressive treatment related to malignant tumors or transfusion of members.

b) Serological diagnostics.

When studying population immunity, it was found to have significant relevance to one another in combining and neutralizing complementarity. In some cases, only neutralizing reflections are found in the patient (Aghayev, 2022: 412).

Conclusion

The human infectious pathology allocates a significant role to SMVI, in which the diversity of clinical signs depends on the localization and distribution of the pathological process and the immune status of the patient (Hughes, 2021: 89). Viral diseases of the mucous membrane of the oral cavity are one of the main places of spread. It has been confirmed that there is a connection between damage to the mucous membrane of the oral cavity, red edging of the lips, skin coverings, genitalia, and SMVI. From the perspective of the interaction between the parasite and the owner, cytomegaloviruses are unusual microorganisms (Gunlemez, 2023: 78). Both intrauterine and lateral viruses (or cytomegaly cells) can be detected in the urine and saliva for a long time, but often high triggers of contraindications to homologous viruses are identified simultaneously. Urine exposure to viruses is noted in children for several months. In the case of this disease, persistent virusemia was identified (they obtain the virus from leukocytes that have not been tampered with) (Shim, 2023: 26). In relatively older children and adults, the virus is excreted with saliva and urine for months. Infection of children after birth was not studied until the end.

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Received: 17.05.2024 Accepted: 02. 06.2024

ISSN: 2707-1146
e-ISSN: 2709-4189

DOI: https://doi.org/10.36719/2707-1146/46/10-14

Sona Hajiyeva
Scientific Research Institute of Medical Prophilaxy
named V.Akhundov
shaclyeva03@mail.com
Sevinj Umudova
Scientific Research Institute of Medical Prophilaxy
named V.Akhundov
umudovasevinc793@gmail.com
Sabira Gahramanova
Scientific Research Institute of Medical Prophilaxy
named V.Akhundov
sebinaqehramanova@gmail.com
Mehran Hamzayeva
Scientific Research Institute of Medical Prophilaxy
named V.Akhundov
shaclyeva03@mail.com

THERAPEUTIC EFFECTS OF PLANT-DERIVED EXOSOMES ON DIFFERENT CANCER CELLS

Abstract

Plant-derived exosomes (PDEs) are natural extracellular vesicles. Research on them has called attention to advances in cancer treatment in recent years. Cancer is the global health crisis of our time and requires treatment that is effective, cost-effective, and has fewer side effects. New studies based on PDEs show that they have great potential to be considered as a therapeutic option. Research results show that the internal molecular charge of PDEs has less toxicity and they have effective anti-cancer activity. The main components of PDEs are lipids, proteins, DNA, and RNA. This review analyzed the available research on the factors that play a role in the effectiveness of the mechanism of action of plant-derived exosomes, based on their potential for medical purposes. As a result of the research, it was determined that the interaction with genes, the form of acquisition, which part of the plant to use, and whether or not an auxiliary agent is used, play an important role in the mechanism of action of such PDEs. It should be noted that the exosomes of each of the investigated plants did not have the same effect on all types of diseases, and their effectiveness varied depending on the diseases.

Keywords: *plant-derived exosomes (PDEs), cancer, DNA, RNA, gene*

Introduction

Human tissue is a cellular hybrid system between cells and the complete organ from a biomedical science perspective (Farley A. 2012:40). Human tissue is a system made up of cells with a specific composition and architecture that performs a specific function, and their cellular matrix (Andari S. 2023: 1053). Extensive studies have been conducted to identify molecules involved in the paracrine activity of stem cells to unlock new therapeutic variants in the concept of cellular based therapy. Plant exosome-like nanoparticles (PDENs) contain a variety of bioactive biomolecules. As an alternative cell-free therapeutic approach, they have the potential to deliver nano-bioactive compounds to the human body, thus leading to a variety of anti-inflammatory, antioxidant, and anti-inflammatory benefits (Andari, 2023: 1053). On the other hand, exosome-like particles of plant origin (PDEN) are believed to have the potential to deliver nano-bioactive compounds to the human body (Farley, 2012: 40). Given current advances and challenges, this work provides a comprehensive and concise overview of the role of PDENs as functional and useful biomolecules for biomedical applications and therapeutics.

ISSN: 2707-1146
e-ISSN: 2709-4189

Research Exosomes are biologically small cellular vesicles with a diameter of 30-150 nm and a density of 1.13-1.19 g/mL, and are excreted naturally by almost all eukaryotic cellular (Ratnadewi, 2023: 182). Because exosomes are considered an essential component, these vesicles resemble molecular components that contain charges such as DNA, RNA, lipids, and proteins and are released into the cellular matrix as a form of intercellular contact (Weaver, 2022: 102272). Cellular vesicles are membrane particles enclosed by a two-layer lipid, including apoptotic bodies, microvesicles, and exosomes. Organisms of all life forms can secrete cellular vesicles into the environment, which serves as an important link between cells and the environment, and also participates in various physiological processes (Willms, 2016: 22519). According to new evidence, plant cellular vesicles play an important role in regulating cross-border molecules with interacting organisms. In addition to transporting signaling molecules (nucleic acids, proteins, metabolic waste, etc.) to mediate cellular communication, the outer vesicles of plant cells themselves can function as functional molecules in cellular micromanagement across cellular boundaries (Zhao-Lin, 2022: 1006299). Several studies have shown that plants can produce vesicles in response to various biotic and abiotic environmental stresses, including pathogenic infections (Zhao-Lin, 2022: 1006299).

Plant-derived vesicles (PDVE) are structurally and functionally similar to animal-derived vesicles (MDVE) and contain large amounts of proteins, lipids, nucleic acids and metabolites necessary for inter-cell signaling relationship (An, 2006: 1009-1019; Alfieri, 2021: 498). In particular, signal transmission is between types. (Garaeva, 2021: 6489). Nucleic acids and proteins in herbal vesicles alter the physiological activities of animal cells (Mu, 2014: 1561). Unlike animal vesicles, PDVEs are easier and faster to extract, cost-effective and do not contain ethical problems (Fujita, 2018: 5772). Compared to synthetic lipid vesicles, PDVEs are safer. New emerging evidence suggests that PDVEs have good prospects in the development of nano-precision systems (Bokka, 2020: 1852).

Tumor micromanagement (TME) is completely different from the normal physiological environment and is a prerequisite for supporting the reproduction and metastasis of cancer cells. However, this unique TME also makes it difficult to treat cancer. For example, low TME pH may worsen before taking chemotherapeutic drugs. Inflammatory micromanagement significantly increases cancer prevalence, metastasis, and resistance to the drug. The relatively hypoxic environment facilitates neoangiogenesis and provides a constant food supply for the growth of cancer cells (Zhao, 2023: 6847). Also, chemotherapy does not perfectly target tumors and often cannot completely remove cancer cells and can even damage more normal cells while killing tumor cells (Behranvand, 2022: 507). Taking into account all these important indicators, the main objective of our work is to test the potential for plant exosome-like nanoparticles (PDENs) for biomedical purposes, by collecting and analyzing data from the latest relevant research and developments.

Conclusion

In six runs, PDENs reportedly kept tumor growth in vowels. Broccoli is known to inhibit the growth of miR159 breast cancer cells across borders (Zhao-Lin, 2022: 1006299). Ginseng extracellular vesicles, dependent on TLR4 and MyD88, promote the transformation of tumor-associated macrophages from the M2 phenotype to the M1 phenotype and inhibit the growth of melanoma (Cao, 2019: 326). Cellular vesicles extracted from the leaves and stems of the dendrobium inhibit the expression of TYR, TRP-1, and TRP-2, the gene MITF, and tyrosine-related proteins associated with melanin production, causing melanin reduction in melanoma cells (Yang, 2021: 259). In addition to cellular vesicles, grapefruit extracellular vesicles have been shown to stop melanoma cell cycles at point G2/M and inhibit melanin proliferation (Zhao-Lin, 2022: 1006299). Asparagus cell-to-cell vesicles inhibit the proliferation of cancer cells by decreasing the expression levels of Ki67 and PCNA in liver cancer cells and increasing the protein levels of AIF, Bax, and Bak. Caspase-9 causes the breakdown of key cellular proteins, including the DNA repair enzyme PARP, resulting in the death of cancer cells (Zhao-Lin, 2022: 1006299). In addition, citrus lemon

ISSN: 2707-1146
e-ISSN: 2709-4189

exosomes have been shown to specifically inhibit a variety of tumor cell lines by reaching the tumor area and activating apoptotic cell death by trailer-mediated cancer: A549 (human lung cancer cell line), SW480 (human colorectal adenocarcinoma cell line), LAMA84 (chronic myeloid blood cancer cell line) cancer cell proliferation (Raimondo, 2015: 19514). Cellular vesicles derived from garlic have anti-cancer properties against A498 (the cell line of human renal carcinoma). In tumor cells treated with cellular vesicles of garlic, expression levels of proapoptotic genes such as p53, Bax, Cas3, and Cas9 increased significantly and expression levels of Bcl-2 antiapoptotic genes decreased significantly. As a potent angiogenic factor, VEGF secretion, which adversely affects tumor angiogenesis in cancer cells, was significantly reduced (Ozkan, 2021: 14773). Consequently, plant cellular vesicles are able to prevent the proliferation and metastasis of cancer cells activate cellular apoptosis, and interfere with the tumor cell life cycle through immune pathways (macrophages and B lymphocytes) and direct effects. However, it should be noted that each of the plant exosomes did not achieve successful results in all directions and are not effective in the same diseases. As mentioned above, each herbal exosome has had successful results in different diseases. Even these results were influenced by which parts of the plants were used and by which they were obtained.

In addition to these, bitter melon exosomes in combination with the chemotherapeutic drug 5-fluorouracil (5-FU) increase cytotoxicity and reduce 5-FU resistance during oral squamous cell carcinoma cell (OSCC) therapy by lowering the expression of inflammatory NLRP3. Extracellular vesicles of bitter melon cause apoptosis in oral squamous cell carcinoma cells by stimulating mitochondrial damage by ROS-mediated administration, a process probably mediated by MAP30 protein (Yang, 2021: 259). To inhibit the development of the brain tumor, miR17 was capsulated in greiffuteczosomes coated with folic acid and polyethyleneimine, miR17 was rapidly delivered to the brain intranasally, and GL-26 was selectively received by cancer cells. GL-26 induced the expression of MHC1 in cancer cells, killing cancer cells and leading to the activation of healthy cells (Zhao-Lin, 2022: 1006299). Some research groups have combined grapefruit-derived vesicles with aptamer HA1 to load the chemotherapeutic drug azithromycin to target and kill HER2+ breast cancer cells (Tang, 2020: 186). Coating grapefruit exosomes with membranes of activated leukocytes increases the expression of LFA-1 or CXCR1 and CXCR2 and improves the involvement of grapefruit exosomes in cancer cells. Capsulated doxorubicin in grapefruit exosomes was successfully delivered to CT26 colon cancer and had a tumor-killing effect (Zhao-Lin, 2022: 1006299). These research findings suggest that, in practical applications, in addition to using the original herbal extraselular vesicles directly as a medicinal product, we are able to point out that the role of supportive genes to enhance its targeting, specific tumor-specific ability, as well as the differences in the chemical compound used as a means of capsulization to increase activity, could open bright doors in the future for a large number of chronic and oncological diseases to continue furthering these investigations for the long-term mechanism of action of exosomes and at the same time for effective and economically appropriate therapeutic use.

In the research analyzed, extracellular vases of various plants have been found to have significant results in the treatment of chronic diseases, whether oncological or human. The plants used in the analyzed studies and the diseases in which their exosomes are affected are shown in Table 1.

Table 1.
Diseases in which exosomes of various plants are most effective:

1	Ginger	Colon cancer, inflammation of the lungs, oral diseases, colitis
2	Greyfurt	Regeneration of intestinal tissue and tumor
3	Lemon	Liver, spleen, and kidney tumors, stomach cancer
4	Rice	Blood sugar and metabolizes regulation
5	Broccoli	Breast cancer
6	Ginseng	Melanoma
7	Blackberry	Insulin Resistance and Liver Fungal Disorder
8	Dendrobium	Melanoma
9	Beech tree	Cervical cancer caused by the human papillomavirus
10	Asparagus	Liver cancer
11	Maize	Intestinal tumors
12	Garlic	Renal carcinoma
13	Bitter melon	Brain tumor

We have determined that the mechanisms of action of exosomes derived from the roots, leaves, fruits, and stems of plants used at the time of our investigation are different, but also that the effect of acquired vesicles on genes varies and may affect the expression of genes. If so, it makes sense to say that these exosomes are similar to human exosomes, in that PDENs, such as stem cells, have the ability to recognize troublesome cells and tissues without affecting tissues other than damaged tissues (healthy) in the body. Because research is ongoing in this direction, more plants, genes, and diseases should be involved in the research to confirm these findings. We cannot say that each of the plant-based exosomes is necessarily capable of affecting the entire oncology or any disease. An analysis of the studies found that each of the plants examined could have different effects on one or more diseases, which showed different effects on each plant that did not apply to exosomes derived from all parts of a plant. In ginger and lemon plants, more than one part was different and yielded significant results in the same direction. It should also be noted that the mechanisms of excretion, impurities, and concentration play a role in the mechanism of action. Lastly, the role of herbal exosomes in cancer treatments will be tremendous. This allows not only the ability to selectively target cancer cells but also the importance of specific plant parts.

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Received: 28.04.2024 Accepted: 29.06.2024

ISSN: 2707-1146
e-ISSN: 2709-4189

DOI: https://doi.org/10.36719/2707-1146/46/15-18

Ruslan Aliyev
Azerbaijan State Advanced Training Institute for Doctors
named after A.Aliyev
dr.ruslan@mail.ru

CHRONIC DISEASES OF THE VENOUS SYSTEM – AS MORPHOLOGICAL AND FUNCTIONAL DISTURBANCE OF THE VENOUS SYSTEM

Abstract

Our goal in this study is to provide quantitative and qualitative data for proper treatment planning in patients with multiple cutaneous computerized tomographic angiography with peripheral artery disease, to detect the spread of peripheral artery disease in the lower extremities, and to detect the density and types of collateral pathways in aortoiliac occlusive diseases.

Keywords: *chronic disease of the venom, surrounding arteries, peripheral, arterial disease*

Introduction

Chronic diseases of the Venus– all morphological and functional disorders of the venous system. The main nozological forms of Chronic diseases of the Venus are considered to be varicose veins of the lower extremities, postthrombotic syndrome (disease) of the lower extremities, and angiodysplasia (flebodysplasia). Frequent telegeniectasis in adults is not considered a disease (Clinical Protocol for diagnosis and treatment of Chronic Disorders of the Lower Extremities, 2013: 7-14).

Varicose veins disease (VX) is a disease characterized by a primary varicose veins transformation of the superficial veneers. Postthrombotic syndrome (PTS) (disease) is a disease caused by organic damage to the deep veneers caused by an incurable thrombosis (Clinical protocol for Diagnosis and treatment of chronic disorders of the lower extremity veneers, 2013: 7-14).

The KEAP classification is used practically around the world in the classification and diagnosis of chronic venous disorders (American Venous Forum, 1995).

Types of diagnostic examinations when examining a patient who is considered to have a chronic disease of venous:

1. Setting the fact that there is a chronic disease of venous
2. Determination of Nosological Variation of a chronic disease of venous
3. Determination of treatment strategy: the need to use surgical methods in the correction of the disease or restriction on conservative methods
4. Identification of treatment tactics: which treatment methodology (or combination of them) to apply
5. Objective evaluation of the effectiveness of the treatment.

The following diagnostic methods are used to address the above issues of Venus' chronic diseases:

- Clinical examination (review, palpation, complaints, collection of anamnesis)
- Ultrasound dopplerography
- Ultrasound angioscanning

Clinical examinations involve targeted collection of patient complaints and anamnesthetic information, and visual assessment of disease manifestations. Relative specific complaints for chronic venous insufficiency include:

- Pain in calf muscles (mass, sprains)
- Weight in calf muscles
- Feet fatigue (reduced tolerance to static overload)
- Strap, side.

These complaints can be quite variable, usually with the following law:

- complaints are strengthened during inadequate activity of the calf muscle pump (long-term "sitting" or "standing" condition) or towards the end of the day;
- regresses during the calf muscle activity, after resting in a horizontal position, or during the use of medical compression products.
- there may be changes in the intensity of venous insufficiency in the month and season;
- in young and middle-aged women, complaints may intensify before menstruation.

Peripheral arterial disease of the lower extremity arteries is a high, chronic, and progressive disease (Benhamou, 2008:193- 219). In the development of Peripheral Arterial Disease smoking, hypercholesterolemia, hypertension, and diabetes are major risk factors (Hertzer NR. 1991:83(2): 112-119; Meijer, Grobbee, Hunink, Hofman, Hoes, 2000:160 (19): 2934-2938; Norgren, Hiatt, Dormandy, Nehler, Harris, Fowkes, 2007; Rulon, Hardman, Jorge, Lopera, Rex, Cardan, Clayton, Trimmer and Shellie, 2011: 197).

Material and methods.

Atherosclerotic vertebrae (n= 3846), assessed by the length of the vial; 1322 vial (% 34.4) <1 cm, 1147 vial (%29.8) 1-3 cm, 297 vial (%7.7) 3-5 cm, 254 vial (%6.6) 5-10 cm and 826 vial (%21.5) >10 cm were seen.

Viewed by age groups (n= 7090), atherosclerosis detected segment count(n= 3846) and frequency of seizure at segment base; 20-45years (n=373) in 129 segments (% 34.6), 46-60 years (n=2006) in 860 segments (% 42.9), 61-75 years (n=3389) in 1950 segments (%57.5), and >76 years (n=1322) in 907 segments (% 68.6) were observed. Statistically significant correlation between age groups and atherosclerosis detected segment density (p<0.01) and positive correlation of „multiple zeros ‟ was detected. (r=0.201, p<0.01) (Table 1).

Table 1. Atherosclerosis detected segment number distribution by age groups

		atherosclerosis. yes.no		Total S.A.
		no atherosclerosis	has atherosclerosis	
30-45 years old	244 65.4%	129 34.6%		373 100%
46-60 years old	1146 57.1%	860 42.9%		(2006) 100%
61-75 years old	1439 42.5%	1950 57.5%		3389 100%
>76	415 31.4%	907 68.6%		1322 100%
Total S.A.	3244 45.8%	3846 54.2%		7090 100%

When cases constituting the study group (n=250) were evaluated by gender (Ariv, Elhan, 87-100, Zwiebel, Pellerit: 268); the study group consisted of 83% men (n=208) and 17% women (n=42). In this context, the frequency of Peripheral Arterial Disease (PAD) occurrence in the study group was statistically higher in men than in women. (p<0.05).

PAD detected segment (n= 3846) was identified as segment withholding percentage; % 51.2 in females (n=644) and % 54.9 in males (n=3202) when looked at distribution of frequency by gender. According to these results, we concluded that the frequency of atherosclerosis detection in men is statistically higher than in women (p=0.017) (2).

Table 2. Distributions of PAD detection segment frequency by gender

		atherosclerosis. yes.no		Totals
		no atherosclerosis	has atherosclerosis	
Gender	Man	2630 45.1%	3202 54.9%	5832 100%
	Female	614 48.8%	644 51.2%	1258 100%
	Totals	3244 45.8%	3846 54.2%	7090 100%

In thePAD detected segments (n= 3846), the relationship between occlusion and gender was detected in a total of 253 segments (% 39.3). In females, the frequency of occlusion in PAD detected segments (% 39.3) was higher statistically than that of males (%29.6.) (p<0.01). According to these results, we concluded that PADs ‟ have a more occlusive progression in female patients . In PAD detection segments (n= 3846) looked at the relationship between plasmid morphology and gender; in males (n=3202) 1562 plasmids (% 48.8) were seen as calcified, 1640 plasmids were calcified (% 51.2); in females (n=644) 407 plasmids (% 63.2) -calified, 237 (% 36.8) plasmids were calcified. The statistically significant difference in genital ratios with plaque morphology was significant (p<0.01). According to these results, it was concluded that females had statistically higher percentages (63.2%) than males (48.8%) (Wilhelm Schaberle, Yurdakul, Tola, Özdemir, Bayazit, Cumhur, 2006: (43) 707-713; Kim, Won, Park, Lee, 2003: 4: 179-183).

Conclusion

PAD was observed in males (n=3202) 1126 plastics (%35.2) <1 cm, 969 plastics (% 30.3) 1-3 cm, 256 plastics (% 8) 3-5 cm, 205 plastics (% 6.4) 5-10 cm, 646 plastics (% 20.2) >10 cm; in females 196 plastics (% 30.4) <1 cm, 178 plastics (% 27.6) 1-3 cm, 41 plastics (% 6.4) 3-5 cm, 49 plastics (% 7.6) 5-10 cm, 180 plastics (%28) >10 cm when viewed at the plum length distribution by gender in the detected segments (n = 3846). It was found that the distribution of the length of the atherosclerotic vial by gender showed statistically significant diversity (p<0.01). For these results, men had a statistically higher frequency of <1 cm (%35.2) compared to women (%30.4) (p<0.01). A(%28) percent with men (% 20.2) was found to be statistically significant higher (p<0.01).

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ISSN: 2707-1146
e-ISSN: 2709-4189

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Received: 11.05.2024 Accepted: 05.07.2024

ISSN: 2707-1146
e-ISSN: 2709-4189

DOI: https://doi.org/10.36719/2707-1146/46/19-27

Natig Suleymanov
Azerbaijan State Academy of Physical Education and Sport
PhD student
natigsuleymanov@icloud.com

PUBIC SYMPHYSIS. BIBLIOGRAPHIC REVIEW

Abstract

Pubic symphysis, also known as osteitis pubis, is an inflammatory condition of the pubic symphysis, clinically characterized by severe pelvic pain, abnormal gait with the increased base of support, and bone destruction of the pubic symphysis margins. Initially associated with certain surgical interventions, speculation about its pathogenesis includes infection, trauma, local vascular anomalies, and reflex-sympathetic dystrophy. This confusion about its etiology is reflected in the wide variety of treatments that have been used over the years, including radiation, bed rest for long periods, infiltration with local anesthetics, anti-inflammatories nonsteroidal drugs, antibiotics, heparin, surgical debridement, wedge resection of the pubic symphysis, and autologous iliac bone transplantation. Both bony infection and inflammation of the pubic area are rare. In the medical literature these two entities have been frequently confused, so that many diagnosed cases of osteitis pubis have actually been shown to be misdiagnosed osteomyelitis pubis. For this reason, an aggressive diagnostic approach is recommended, especially in post-surgical cases, with biopsy and arthrocentesis of the symphysis guided by computed tomography.
Keywords: *arthritis, pubic, symphysis, osteitis, pubis*

Introduction

Pubic symphysis, also known as osteitis pubis, is an inflammatory process of the pubic symphysis, which causes intense pain and bone destruction of the articular surfaces of the pubis. Despite 7 decades of speculation about this disease and although it has traditionally been considered a non-infectious entity, the truth is that even today its pathogenesis, diagnostic criteria, natural history, and optimal treatment continue to be controversial issues. The scientific literature contains numerous cases of pubic osteomyelitis initially diagnosed as osteitis pubis, which is why many researchers currently maintain that this condition may be, in a high proportion, secondary to infection. This review article reviews the different affections of the symphysis pubis, their terminology, symptoms, diagnosis, and most correct treatments, trying to adequately classify each entity and make a correct distinction between infectious and non-infectious conditions.

Anatomical Considerations

The pubic symphysis is an amphiarthrodial joint located at the confluence of the 2 pubic bones. A small fibrocartilaginous disc is interposed between 2 narrow sheets of hyaline cartilage. The articular surfaces lack an adequate synovial membrane, which prevents the important destructive processes that take place in inflammatory arthropathies, such as rheumatoid arthritis. Biomechanical analyzes of the pelvis show that this set of bones functions as a group of arches that transfer the weight of the trunk from the sacrum to the hips. There are three ligaments that confer stability to the pubic symphysis: the superior, the anterior, and the inferior; the latter –also called the arcuate ligament– is primarily responsible for maintaining joint stability. This ligaments allow only minimal movement of the joint during most bodily activities, although some degree of angulation, rotation, and displacement that occurs during work on the sacroiliac and hip joints is possible. In the case of women, in the last months of pregnancy, and especially during childbirth, there is a certain separation of the pubic bones. The symphysis is richly innervated with branches of the pudendal and genitofemoral nerves, which explains the intense pain that inflammatory conditions of this small joint can cause. The blood supply is provided by branches of the pudendal, inferior epigastric, and mid-femoral circumflex arteries. As for the musculature that is involved in the pubic

ISSN: 2707-1146
e-ISSN: 2709-4189

symphysis, it includes the rectus abdominis, the gracilis, the pectineus and the adductors, both long and short.

Terminology.

In 1924, Beer (Beer, 1924) coined the term osteitis pubis to describe a post-surgical complication of suprapubic prostatectomy, characterized by severe pelvic pain, abnormal gait with increased base of support, and bone destruction at the margins of the symphysis pubis. For decades there has been significant terminological confusion, as well as numerous imprecise definitions of the condition, which have contributed to making this syndrome a controversial pathology, whose origin is not completely clarified. From a strict point of view, pubic symphysis consists of an enthesopathy of the pubis, that is to say, a painful inflammation of the muscular insertions in the area of the pubic rami (Montes Gonzalez, 2002). It is interesting to consider the various terminologies used to define pubic enthesopathy: pubalgia, pubitis, osteitis pubis, pubic symphysitis, pelvic-arthrosis syndrome, dynamic osteopathy of the pubis, traumatic inguinocruralgia, adductor disease, pubic osteopathy, pubic osteopathy, sports hernia, sports pubalgia, athletic pubalgia, lumbo-abdomino-pubalgia, and lumbopubalgia. In turn, the term pubic symphysis is somewhat imprecise when it comes to defining what type of pathology of the pubic joint we want to refer to. From the outset, the suffix -itis speaks of an inflammatory affectation, without specifying its possible infectious, traumatic, or other type of etiology. From a practical point of view, we could classify the diseases that affect this joint as follows (Gamble, 1986):

Congenital anomalies (such as bladder exstrophy, craniocaudal dysostosis, and Dyggve-Melchior-Clausen syndrome) cause varying degrees of separation of the pubic bones, resulting in a variable spectrum of functional disability. Infections, such as septic arthritis of the pubic symphysis or pubic osteomyelitis, are sometimes misdiagnosed as osteitis pubis to which we will dedicate an entire section of this review. Among the inflammatory diseases, the main one is osteitis pubis or pubic symphysis, the “sterile” inflammation that concerns us in this review. In addition to the above, seronegative spondyloarthropathies can affect the joint, in such a way that in them the progressive ossification of the fibrous elements of the joint conditions a complete synostosis of the symphysis. – Metabolic diseases, such as renal osteodystrophy and hyperparathyroidism, can cause bone resorption. Likewise, arthropathy due to calcium pyrophosphate crystals, ochronosis, and hemochromatosis can also cause joint lesions, consisting of fibrocartilage calcifications, and subchondral bone erosions - degenerative diseases. From the fifth decade of life, degenerative lesions of the symphysis begin to appear, which initially consist of sclerosis of the articular surfaces, with the progressive appearance of marginal osteophytes– neoplasms. As with other joints, the symphysis pubis is resistant to tumor invasion, that is, although tumors, malignant or benign, can affect the pubic bone, they rarely reach the joint. There may be bilateral involvement of the pubis in the case of metastatic carcinoma, myelosclerosis, multiple myeloma, and Hodgkin's disease. Unilateral bone involvement occurs in benign lesions, such as desmoplastic fibroma, and the symphysis is always intact. – post-traumatic disease. With four typical lesion patterns: pubic diastasis (the most frequent; 45% of the total), displaced fracture, intra-articular fracture with dislocation-overlapping, and finally a combination of the above. The pathologies that most frequently affect the pubis are of non-infectious etiology, although other important etiologies will be taken into account in the differential diagnosis, such as septic arthritis, whose early identification is essential to avoid not only the poor prognosis derived from a therapeutic intervention late but even the death of the patient.

Etiology.

Traditionally, and in general terms, pubic symphysitis has been considered an inflammatory process of non-bacterial origin that presented as a complication of various types of surgical interventions (Henderson, 1950; O’Learly, 1964; McGinn,1949; Klinefelter, 1950) (especially urological and gynecological), pregnancy and childbirth (Wiltse,1956; Wilensky, 1938; Golden, 1952) trauma ,(Klinefelter, 1950; Wiltse, 1956; Leucutia, 1951), herniorrhaphys (Harth, 1981) and pyelonephritis (Kleinberg, 1942). However, the theory that osteitis pubis is a non-infectious disease

is in direct conflict with the record of numerous cases that do not recover with conservative treatment (Henderson, 1950; Wiltse, 1956), patients who even develop perineal fistulas (Henderson, 1950; Adams, 1953; Barnes, 1933) and patients whose osteitis pubis is associated with infections of a surgical wound (Henderson, 1950; O'Learly, 1964; Barnes, 1933), positive blood cultures (Wheeler, 1941) or the finding of an abscess adjacent to the pubis (Barnes, 1933; Goldstein, 1947). Added to this is the fact that most patients with osteitis pubis who undergo bone biopsy show changes suggestive or typical of osteomyelitis (Adams, 1953; Goldstein, 1947; Lavalle, 1951; Friedenberg, 1950; Lame, 1954). In cases where an infectious origin is identified, the most frequently isolated germs are Staphylococcus aureus, followed by Pseudomonas aeruginosa and, lastly, polymicrobial infections (Ross, 2003). In numerous cases of osteitis pubis with good evolution after conservative treatment, it is inferred that there is no infection because the symptoms disappear without antibiotic treatment. However, the absence of symptoms should not be considered the basis for determining that the patient does not have pubic osteomyelitis, since in the scientific literature there are several cases of pubic osteomyelitis that resolve "spontaneously" without antibiotic treatment (Lavalle, 1951; Sexton,1993). Despite all these arguments, the concept that osteitis pubis is a non-infectious disease has persisted to the present day, appearing as such in many trauma, urology, gynecology, and radiology textbooks. Other authors have speculated about its etiology, in such a way that in 1941 Wheeler (Wheeler, 1941) proposed the theory that the origin of the condition resides in a sympathetic-reflex dystrophy of the pubis. More recently, in 1980, an attempt was made to associate it with thrombosis of the parapubic veins, (Nisenkorn, 1980) which would cause difficulty in venous return of the joint, proposing the administration of heparin as a treatment for the condition. However, these two hypotheses have not been supported by very solid arguments. Apart from these considerations about its etiology, the truth is that its appearance is especially frequent in athletes, who are running and suddenly changing direction. Thus, numerous studies show that the disease does not have the same incidence in all population groups: it is much more frequent in men (5:1 ratio) (Montes Gonzalez, 2002), and not due to morphological differences between the sexes, but rather due to activities traditionally linked to the male sex. Some authors define this pathology as inflammation due to overuse associated with some sports (Lieberman, 1997).

According to the study by Renstrom, (Renstrom, 1992;) the sports with the highest risk are:

1. Soccer (50% of cases).
2. Long distance runners.
3.Rugby.
4. Weightlifters.
5. Cyclists.

If we stick to the sports field, to know the etiological factors involved in the origin and development of pubic symphysis it is essential to differentiate between two clinical forms of the disease (Danowskik, 1992):

Microtraumatic pubic osteoarthropathy (traumatic pubalgia).

It appears as a consequence of an attack on the symphysis pubis. There are two possibilities regarding its etiology: – It may be the consequence of a fall on the feet in which the forces of reception on the ground are unequal, so that one pubic branch rises more than the other, causing shearing of the pubis, with stretching of the pubic ligaments. – The loss of support on the ground, or an opposition movement on the lower extremity, can cause sudden tension on the adductors, causing stress that can damage the ligaments or muscle insertions located in the pubis.

Chronic groin pain.

Unlike the previous one, in chronic pubalgia the pubis is not the cause of the pubalgia at all, but rather it results from an altered functional scheme. It admits, in turn, a subclassification into two types:

– Upper pubalgia, secondary to involvement of the rectus abdominis muscle.

– Lower pubalgia. The damage originates in the adductor musculature, generally being the median adductor the cause of pubic osteopathy.

It should be noted that the studies carried out to date point to a series of triggering factors, which are classified into two groups: intrinsic factors, such as shortening of the lower extremities, lumbar hyperlordosis or abdominal wall and/or inguinal tract deficiencies, and extrinsic factors, such as the quality of the sports field, overtraining or the practice of certain dangerous movements.

Frequency.

The incidence of this pathology in the general population is not fully established, but numerous studies show that there is a strong association, among other situations, with pelvic organ surgery (Beer, 1924; O'Learly, 1949; Barnes,1933; Wheeler, 1941; Goldstein AE, Rubin, 1947), in such a way that, in Specifically, after urinary incontinence surgery using the Marshall-Marchetti-Krantz technique, an incidence of osteitis pubis is estimated at 2 to 3% (Lentz, 1995). Apart from its relationship with surgery, it is clear that it is a picture with a clear occupational character, that is, pubic symphysis is clearly and indivisibly associated with sports practice. In the study published by Montes González (Montes Gonzalez, 2002) in 2002, which focused on determining the influence of risk factors associated with sports practice, extrinsic factors are analyzed (quality of the ground, overtraining, incorrect training programming, and the practice of certain dangerous movements) in 3 subgroups of individuals:

Class 1: individuals who train regularly, strengthening the abdominal muscles and stretching the adductor muscles.

Class 2: individuals who train regularly, with poor preparation, based on muscle strengthening exercises without control.

Class 3: individuals who do not train regularly (once or not once a week). The results show that class 2 presents a much higher incidence of pathology (7.58%), with group 3 presenting the lowest risk of developing osteopubic osteopathy (1%). The study concludes that the incidence of the pathology, even in a high-risk group such as the one considered (assuming the overall incidence in the 3 classes), is very low, less than 5%. There is a strong correlation between the diagnosed cases and the months of sports competition, and it shows how overtraining and incorrect physical conditioning will be the triggering elements of the pathology, while the performance of preventive exercises (adductor stretching, abdominal and hamstring strengthening) significantly reduces the chances of suffering from osteopubic osteopathy.

Clinical Manifestations.

The classic symptom of pubic symphysis is pain in the suprapubic region, which can radiate to the groin, hips, and thighs, following the path of the adductor musculature[28] (Sequeira W. Diseases of the pubic symphysis. Sem Arth Rheum. 1986). Walking, going up or down stairs, monopodal support, or a sudden change of direction during walking intensify the pain. You may also notice a clicking sound when getting up from a seat, turning over in bed, or walking over uneven ground. The patient has a typical ambulation with the increased base of support. Hip flexion or hip abduction and rotation in flexion cause pain. However, these maneuvers are painless with the hip in extension. A variable degree of erythema, edema and local temperature increase may appear, and in some cases fever can even be detected (Sequeira, 1986). During gait, suprapubic pain may be due to the development of torsion or compression forces on the inflamed symphysis. The interosseous ligaments of the sacroiliac joints have great stabilizing power and allow only imperceptible movement of the joint. This movement becomes 0.5 mm in the symphysis in men, and 1.5 mm in non-pregnant women. However, even small mobilizations of the sacroiliac joint, when amplified by the lever represented by the pubic rami, can cause detectable movements in the pubic symphysis.

Differential Diagnosis.

Historically, there has always been confusion between pubic symphysis (sterile inflammation of the pubic symphysis), osteomyelitis pubis, and septic arthritis of the pubic symphysis (Table 1). The first of these syndromes (pubic symphysis) is clinically indistinguishable from pubic osteomyelitis, and in order to make an adequate diagnostic differentiation it is necessary to obtain negative

cultures (Ross, 2003). Furthermore, to complicate the distinction between these entities, antibiotics, surgical debridement, glucocorticoids, and nonsteroidal anti-inflammatory drugs (NSAIDs) have been used for the treatment of osteitis pubis. Many cases of osteomyelitis are initially misdiagnosed as osteitis pubis, especially after urological surgery (Sexton, 1993; Bouza, 1978; Gilbert, 1975; Rosenthal, 1982) Sexton et al.· (Sexton, 1993) reported a case of pubic osteomyelitis resolved despite an inadequate antibiotic regimen, suggesting that many cases of "low-grade" osteomyelitis pubis are diagnosed as osteitis pubis, with slow and spontaneous healing, in most cases due to immune containment (in the same way that in the pre-antibiotic era some vertebral osteomyelitis resolved without specific treatment). In fact, this contention phenomenon is supported by a recent study (Karpos, 1995)in which it was shown that up to 71% of patients with osteitis pubis after urological intervention using the Marshall-Marchetti-Krantz technique had positive bone biopsy cultures. The second pathology that must be taken into account when making a differential diagnosis is septic arthritis of the pubic symphysis. Inflammation from pre-existing osteitis pubis may predispose to septic pubic arthritis if S. aureus bacteremia occurs (Img. 1). In the review article by Ross and Hu (Ross, 2003) published in Medicine, there are 100 cases of septic arthritis documented from 1973 to 2003, identified in Pubmed. The cases were accepted if there was microbiological isolation from arthrocentesis, surgical debridement, or blood cultures, together with images that supported the septic process in the symphysis. Of the 100 cases, 34 were caused by S. aureus, 24 by P. aeruginosa, 19 were polymimicrobial, and the rest were caused by Escherichia coli and other gram-negative bacilli. Clinically, it is striking that only 74% of the cases presented with fever, although 88% had pubic pain. 59% presented an abnormal gait, and 45%, had pain with hip movements. Inguinal adenopathies were detected in only 4% of the cases. Regarding the laboratory, only 35% of the patients had leukocytosis, the mean erythrocyte sedimentation rate (ESR) was 83 mm/h, and germs were isolated in 86% of the symphysis pubis aspirate (Img. 2). Four large risk groups were identified: women with recent surgery for urinary incontinence, athletes, pelvic neoplasms, and intravenous drug addiction (IVDA).

Table 1.

Characteristics of osteitis pubis compared with osteomyelitis pubis and septic arthritis of the pubic symphysis

	Osteítis pubis	Osteomielitis pubis	Symphysis pubis septic arthritis
Naturale	Inflamation	Infectionous	Infectionus
Location	Insertion of the musculature in the pubic symphysis	Bone tissue of the pubic rami	Pubic symphysis joint
Culture	Negative	Positive	Positive
Etiology	Overuse (athletes), trauma, pelvic surgery, pregnancy and childbirth	Pelvic surgery, abdominal pathology, IVDA, pregnancy and childbirth	Pelvic surgery, abdominal pathology, IVDA pregnancy and childbirth
Clinic	Pelvic pain, abnormal gait	Pelvic pain, abnormal gait	Pelvic pain, abnormal gait
Imaging techniques	Conventional radiography CT, MRI, bone scintigraphy	Conventional radiography CT, MRI, bone scintigraphy	Conventional radiography CT, MRI, bone scintigraphy
Treatment	Self-limited, rest, NSAIDs, corticosteroids	Antibiotics, NSAIDs, rest, surgery for complicated cases	Antibiotics, NSAIDs, rest, surgery for complicated cases

IVDA: intravenous drug addiction; NSAID: nonsteroid antiinflamtory drugs; MR: magnetic resonanse; CT: computer tomografy.



Image 1.
Pelvic computed tomography: bilateral erosions (arrows) of the symphysis pubis in a 38-year-old patient with septic arthritis of the pubis due to Staphylococcus aureus.

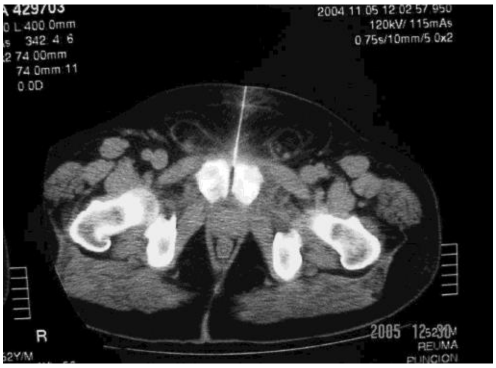
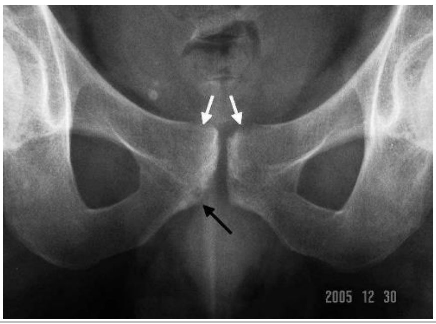


Image 2.
Image taken during a computed tomography-guided symphysis pubic aspirate. The path of the puncture needle can be seen from the skin plane to the joint cavity.

Diagnosis. Complementary Explorations.

The initial suspicion that the patient has osteitis pubis is given by typical clinical manifestations (intensified suprapubic pain when walking, going up or down stairs and, of course, when running, together with an abnormal gait) in a patient with a Congruent medical history (athletes, history of surgery, etc.). Regarding the complementary tests, the laboratory techniques are usually unremarkable, or at most there is a slight leukocytosis, with increased values of ESR28. Conventional radiology is often normal in the initial stages, and in more advanced stages it shows sclerosis of the articular surfaces (Img. 3) and even some erosion of the subchondral bone, which typically appears bilaterally.

Diagnostic delay is quite common, taking into account that it is an infrequent pathology and that it is difficult to establish a differential diagnosis with urological, gynecological, and even abdominal conditions (Pauli, 2002). The time between the onset of symptoms and the diagnosis of osteitis pubis usually varies from weeks to months in most cases, although the average time is approximately 30 days. Bearing in mind –as we have seen in the differential diagnosis section– that osteitis pubis is clinically indistinguishable from pubic osteomyelitis, more specific imaging techniques may be required to carry out a correct diagnosis (Img. 4) than a simple X-ray of pubic symphysis. In this sense, magnetic resonance imaging (MRI) and computed tomography (CT) can show inflammatory changes in the bone that point the condition toward osteomyelitis. The images that usually appear on MRI consist of bone destruction, joint effusion, and widening of the symphysis, and may reveal the presence of a mass and edema of the adductor and obturator muscles (Ross, 2003). CT findings basically consist of bone erosions (Img. 5), abscesses, phlegmon, marginal irregularities of the symphysis, and joint widening. However, to definitively rule out the existence of a condition of infectious origin, a CT-guided bone biopsy (Lupovitch, 1989) and an arthrocentesis of the symphysis are required, to obtain samples for microbiological (aerobic and anaerobic culture) and histopathological (Sexton, 1993) processing.



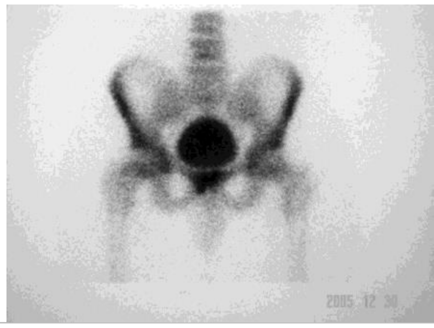


Image 3.	**Image 4.**
Conventional radiograph of a patient with osteitis pubis. Some sclerosis of the articular surfaces can be seen, together with some subchondral geode (black arrow) and bilateral erosions (white arrows), more marked on the left ramus.	Bone scan of a patient with osteitis pubis. A very significant increase in the deposit of the radioisotopic tracer is observed in the pubic symphysis.



Image 5.

Pelvic pubic CT scan of a 52-year-old patient with Pseudomonas aeruginosa septic arthritis of the symphysis pubis. Note the unilateral presence of erosions on the articular surface of the symphysis (arrow).

Forecast.

Osteitis pubis, understood as sterile inflammation of the pubic symphysis, is an entity with a good prognosis (some authors (Pauli, 2006) even describe it as a self-limiting process), which in most cases usually responds well to conservative treatment (Montes Gonzalez, 2002). With the correct diagnosis and treatment, resolution of the condition is usually achieved in approximately 4-6 weeks. On the contrary, osteomyelitis pubis and septic arthritis of the pubic symphysis are pathologies of greater importance; require hospitalization for intravenous treatment and can cause sequelae such as pelvic instability, which can even lead to sacroiliac stress fractures, pubic diastasis, urinary incontinence (especially in patients who develop the condition after surgery), bladder perforation urinary tract and chronic pelvic pain. These pictures of infectious origin even have an associated mortality that oscillates around 2%, according to the series of 100 cases by Ross and Hu (Ross, 2003).

Treatment.

The existing confusion about the origin of this disease is reflected in the great variety of treatments used in these patients during the last 50 years. The different therapeutic options include radiation, absolute bed rest for prolonged periods, infiltration with local anesthetics with or without glucocorticoids, NSAIDs, antibiotics, heparin, surgical debridement, wedge resection of the pubic symphysis, and iliac bone autologous transplantation (Sexton, 1993). In order to establish the

correct treatment, it is obviously essential to rule out the existence of an infectious basis. For osteitis pubis understood as such, that is, sterile inflammation of the bone and periarticular soft parts of the pubis, conservative treatment is usually sufficient. The basis of this therapy consists of sports rest for 4-6 weeks, physical therapy (isometric work on abductors, adductors, rectus abdominis, and obliques), and NSAIDs. In cases without response to previous treatment, infiltrations with local anesthetic and corticosteroids can be performed. Surgery is rarely indicated, and it is estimated that it may be necessary in 5 to 10% of cases. The article by Mehin et al. (Mehin, 2006) basically identifies 4 types of surgical intervention: curettage, arthrodesis, wedge resection, and wide resection. These authors maintain that athletes with osteitis pubis respond well to curettage, while if the disease is secondary to urological or gynecological interventions, somewhat more aggressive surgery is required in up to 50% of cases. Regarding the cases of symphysis in which a microorganism is finally identified as the cause of the symptoms, the treatment of choice is obviously intravenous antibiotic treatment maintained for at least 4 weeks, 21 continuing with the oral antibiotic regimen for a minimum of 2 weeks more. Sometimes conservative treatment with rest and antibiotics may not be enough to guarantee therapeutic success, thus requiring curettage and surgical cleaning. In the series of 100 septic arthritis of the pubis published by Ross and Hu, 97% had pubic osteomyelitis, and in more than 50% of the cases a surgical attitude was required, consisting mainly of bone debridement and, secondly, incision. and drainage of the abscess.

Discussion. For decades, pubic symphysitis has been defined by its clinical presentation and by its radiological manifestations, although, in most registries, osteomyelitis was not adequately excluded by biopsies or cultures. Many patients presumably suffering from osteitis pubis showed a clinical course suggestive or typical of intra-treated osteomyelitis (abscess formation, fistula development, etc.). Hence, some authors defend the hypothesis that all cases of osteitis pubis are secondary to infection, while others try to separate pubic symphysitis into 2 categories: infectious and non-infectious.

Conclusion

However, in the majority of registered cases and reviews it is assumed that osteitis pubis and osteomyelitis are 2 different entities, and that osteitis pubis is non-infectious in nature. After carrying out this review, it seems reasonable to consider fundamentally 2 questions: firstly, the need to re-examine the concepts concerning the pathogenesis and treatment of osteitis pubis, and secondly, the change in attitude towards patients presenting with pubic pain and radiological findings suggestive of pubic symphysitis, who should undergo symphysis pubis arthrocentesis and CT-guided bone biopsy to obtain samples for microbiological processing to definitively rule out the existence of a underlying infectious disease.

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Received: 29.04.2024 Accepted: 28.06.2024

ISSN: 2707-1146
e-ISSN: 2709-4189

CHEMISTRY

DOI: https://doi.org/10.36719/2707-1146/46/28-33

Khatira Ismayilova
Institute of Petrochemical Processes named acad. Y.H. Mammadaliyev
Xatire19667@gmail.com

THE OIL REFINING INDUSTRY IN AZERBAIJAN AND A BRIEF HISTORY OF THE DEVELOPMENT OF THE CATALYTIC CRACKING PROCESS

Azerbaijan is a country rich in oil in all periods of its history. This is a country that is considered the home of ”black gold “, known as one of the leaders in oil extraction in the world, rich in material and spiritual resources, as well as having the oldest experience in the field of oil extraction.

The article talks about the history of the creation and development of chemistry and petrochemical science in Azerbaijan in ancient times, as well as the process of oil extraction and processing as well as the interest of foreign oil companies in this field and investment for the development of the oil industry in Azerbaijan.

In addition, the works of Russian scientists living in Azerbaijan in this field and the most important results of the fundamental research conducted by Azerbaijan scientists in the development of the oil industry are briefly presented.

In the development of the catalytic cracking processes, which is one of the processes of the oil industry, the fundamental scientific research works oil Azerbaijani scientists and the Institute of Petrochemical Processes named Academician Y.H.Mammadaliyev, the ancient science temple of Azerbaijan, which carries out these works, are mentioned.

Today, the oil industry of Azerbaijan is conquering higher peaks in terms of more efficient use of oil, our natural resource. For the sake of the bright tomorrow of our people.

Keywords: *oil refining, catalytic cracking process, oil wells, fluidized bed, small-dispersed catalyst*

Introduction

In Azerbaijan, the history of chemical concepts is very ancient. As in some other Eastern countries, the emergence of the science of chemistry in Azerbaijan traces its origins to the extraction of ore and the processing of metals. Metallurgy, one of the important industrial sectors, is in turn associated with chemical transformations.

To determine the history of the science of chemistry in Azerbaijan, recent archaeological excavations have studied a large number of material-cultural artifacts from the Eneolithic, Bronze, Iron Ages, and the Middle Ages. These studies indicate that the use of metals began at the end of the 4th millennium BCE and the beginning of the 3rd millennium BCE. According to archaeologists, the first metal known to the ancient population of Azerbaijan was copper.

In the Lesser Caucasus mountains located in the territory of Azerbaijan, copper deposits exist, and the methods of extracting copper were known to our ancient ancestors. It has been discovered that in the 2nd millennium BCE, a high bronze culture existed in Azerbaijan, and the Iron Age began in the 1st millennium BCE. Important ancient iron ore deposits were found in Karabakh, particularly near the village of Bayan in the Ganja region. The famous historian Hamdallah Qazvini also provided information about this. In the territory of the ancient Azerbaijani state of Manna, copper, gold, silver, and other metals were extracted. The Albanian historian M. Kalankatuklu wrote: "This country has all kinds of useful minerals. Gold, silver, copper, and pure clay are extracted from the mountains."

The history of chemical concepts in Azerbaijan is very ancient. As in some other Eastern countries, the emergence of the science of chemistry in Azerbaijan traces its origins to the

extraction of ore and the processing of metals. Metallurgy, one of the important industrial sectors, is in turn associated with chemical transformations (M.İsmayılov Bakı-1993.səh.246-249).

In the Middle Ages, the development and spread of applied chemistry in Azerbaijan had a positive impact on the science of medicine. At that time, medicines prepared based on petroleum, mercury, sulfur, and other substances, in addition to plant-based drugs, were used in medicine.

Notable medieval scholars significantly contributed to the development of chemical science in Azerbaijan: the famous physician and chemist Abu Ali Ibn-Sina, the encyclopedic scholar Nasreddin Tusi, and one of the founders of medicine and applied chemistry, Omer Osmanoghlu was one of the prominent philosophers, mathematicians, chemists, and physicians in Azerbaijan in the 12th century.

The creation and development of chemical science and industry in Azerbaijan, as well as the importance of our valuable natural resource oil are of great significance. The history of oil extraction in Azerbaijan is ancient. Azerbaijan has long been famous as the "land of black gold" and the "land of fires." The first information about the production of oil and its various uses in Azerbaijan is found in the works of the 10th-century Arab scholar and traveler Masudi. In ancient times, oil was mainly used as fuel and a medicinal agent (Khalilov, 1990: 8-45).

In the last hundred years, due to its geographical location in the South Caucasus region, the exploitation of its rich oil and gas reserves, and the implementation of large-scale projects for their export to world markets, Azerbaijan has become a geopolitical center where the interests of the USA, European, and Asian states intersect.

Thus, the oil industry of Azerbaijan has become an important element of its economic and political life. For the first time in the world (eleven years before the USA), an oil well was drilled using technical means in Azerbaijan in 1848 by Russian engineer Semyonov. After this, in 1863, a well was drilled on Pirallahi Island using mechanical methods. In 1869, when master Allahyar drilled a well mechanically in Balakhani, a loud noise at a depth of 10-15 meters scared the workers, leading them to fill the well. Three years later, in 1871, a well was drilled using technical methods in Balakhani, producing 45,000 poods (700 tons) of oil per day (Suleymanov, 1989: 64-75).

In the late 18th century and into the mid-19th century, German Baron Tornay laid the foundation for the production of kerosene (lamp oil) in Azerbaijan. In 1863, Baku engineer Javad Malikov pioneered the production of kerosene (white oil) for the first time. From the 1860s onwards, industrial-scale oil refineries began to emerge in Baku to meet the growing demand. By the late 1870s, there were nearly two thousand oil production facilities operated by various individuals and companies in Baku alone. It should be noted that during the 19th century, the Russian Empire primarily extracted oil from villages on the Absheron Peninsula, marking the beginning of Russia's oil industry.

In 1872, Baku villages produced 5 million tons of oil, and by 1900, this figure rose to 661 million tons, accounting for 95% of the oil produced in the Russian Empire and more than half of the world's total oil production. Additionally, kerosene (white oil) production reached 1,500 tons in 1873, and that same year, Baku technologist A. Tabrizov developed a continuous refining process for oil. By 1875, the volume of kerosene production in Baku had reached 847,700 poods (a Russian measure of weight), and by 1901, this number had increased to 2.5 million poods (Süleymanov,1989: 64-75).

The shortage of oil production in Azerbaijan attracted the interest of foreign states. Major world powers competed for oil in Azerbaijan: American J. Rockefeller's Standard Oil, under the leadership of H. Deterding's Royal Dutch Shell from England, Rothschild's "Caspian-Black Sea" and "Mazut" from the French, and the syndicates of Swedish Nobel Brothers were all active in Baku. The development of the oil industry in Azerbaijan paralleled the role played by Standard Oil in the United States with the Nobel Brothers in Azerbaijan. They established a large-scale oil industry company called "Nafta" in Baku. The founders of this industrial firm were the Nobel brothers Ludwig, Robert, and Alfred, along with their friend Peter Bilderling. By the late 19th

century, this company, led by Ludvig Nobel, earned the title of "Oil King" in the Russian Empire. The Nobel Brothers, who owned the Baku oil refining plant, exported kerosene via the Caspian Sea to Russia's main industrial centers and abroad. At one point, this company controlled 50.1% of the sale of white oil in Russia, a figure that later reached 80.3% in different years.

In the 19th century, the development of oil extraction and refining industries in Azerbaijan was intertwined with the unique global economic system, subject to the technological processes of the era, both successful and unsuccessful. Azerbaijan not only matched the world level in terms of technology, scientific research, and equipment but excelled in many respects.

The development of the oil-chemical and oil refining industries in Azerbaijan is directly related to the scientific works and efforts of scientists and researchers tirelessly engaged in this field. Our scientific history shows that the work of researchers is never easy. It combines long-term scientific observations with tireless experimental searches.

The history of our science is rich with materials that illuminate the dedication, excellence, and profundity of scientific knowledge. It is crucial today to pay special attention to the study of the development of Azerbaijani chemistry and the oil-chemical industry. Just like in other fields, our primary task should be to introduce the younger generation to the scientists and servants of science who have contributed to this field, immortalizing their bright memories in history's annals for future generations and for the world.

The works of eminent scholars such acad. Y.H. Mammadaliyev, M.F. Nagiyev, V.S. Aliyev, H.H. Hashimov, S.J. Mehdiyev, R.S. Guliyev, M.I. Rustamov, B.A. Dadashov, I.M. Orujova, B.K. Zeynalov, S.A. Sultanov, F.I. Samedova, V.S. Qutiyarani, A. Mehdiyev, R.A. Aliyeva, V.M. Abbasov, A.J. Huseynova, E.T. Suleymanova, A.G. Azizov, V.H. Gasimov, M.A.Mammadyarov, and many others have significantly enriched the natural and technical sciences as well as the history of science among the humanities.

The valuable research, inventions, and discoveries in the field of petroleum refining, one of the leading areas of Azerbaijani chemistry, as well as their works discussing vital organisms, can be considered the most valuable source for the history of Azerbaijani chemistry and the oil-chemical industry.

Academician Y.H. Mammadaliyev's book "Development of Science in Azerbaijan," published in 1960, remains a valuable work in the history of science, maintaining its relevance and significance. In this book, Academician Y.H. Mammadaliyev demonstrated that the development of science in Azerbaijan began in the 12th century. He wrote, "... The Azerbaijani people have produced many eminent scholars, thinkers, and poets in their history. They have enriched world civilization and the brilliance of science with their outstanding works..."

Academician Y.H. Mammadaliyev then writes, "... Great thinkers of the 12th century include Abdulhasan Bakhmanyar ibn Marzban and Khalil Tabrizi. The distinguished astronomer of the 12th century, Fereydoun Ali ibn Abdul Karim Shirvani, the famous engineer and scholar Amiraddin Masud Nakhchivani, and the physician and philosopher of the 12th century, Afzaladdin Abdulmalik Khoja, have created valuable scientific works that have reached our era..."

In his book, Academician Y.H. Mammadaliyev provided extensive information about the scientific activities of Azerbaijani chemists, such as Movsum bey Khanlarov and teacher Sadig Huseynov (Məmmədəliyev, 1960: 10-25).

Over the years, both chemistry and the number of scientists working in this field have developed in Azerbaijan.

Academician V.S. Gutiryat, who lived in Azerbaijan for a long time, conducted precise theoretical and experimental research on various hydrocarbon conversion reactions involving alumosilicate catalysts. He developed the industrial method of catalytic cracking in the "fluidized bed" of the catalyst. During his early career, Academician V.S. Gutiryat succeeded in developing the steam phase cracking method and, shortly thereafter, in the mid-1930s (together with M.A. Dalin), he devised a new and advanced technological process for obtaining ethyl alcohol from natural gases, demonstrating effective industrial implementation.

The distinguished scientist V.S. Gutiryat worked for many years at the Azerbaijan Scientific Research Institute of Oil Refining named after V. Kuibyshev (currently the Institute of Petrochemical Processes named after academician Y.H. Mammadaliyev of the Azerbaijan National Academy of Sciences), where he led one of the largest laboratories (12).

During his tenure in Azerbaijan, Academician V.S. Qutiryat authored several monographs, including "Cracking and Reforming of Petroleum Products with Participation of Alumosilicate Catalysts" (1944), "Purification of Thermal Reforming Distillates" (1946), and "Research on Catalytic Cracking of Products using the Fluidized Bed Technique" (1962), among others.

It is worth noting that during World War II, Azerbaijan's oil fields played a crucial role in supplying combat aviation fuel. The Azerbaijani scientists and engineers of that period introduced a number of new innovations in the oil industry, supplying high-octane gasoline technology. During that time, the Allied forces received 75 million tons of crude oil, 22 million tons of gasoline, and other petroleum products.

From 1941 to 1945, scientists at the Institute of Petrochemical Processes named after academician Y.H. Mammadaliyev of the Azerbaijan National Academy of Sciences made numerous scientific inventions and discoveries.

Academician Y.H. Mammadaliyev's achievements in obtaining high-octane aviation fuel and explosive substances during the Great Patriotic War played a significant role in the victory over fascism (Khalilov, 1990: 8-45).

During the war years, Professor Ali Guliyev led a group of scientists who prepared appropriate recipes for obtaining explosive substances and produced incendiary bulbs in large-scale facilities (Khalilov, 1990: 8-45).

In the 1960s and 1970s, under the leadership of academicians V.S. Aliyev and M.I. Rustamov, extensive research was conducted on improving the catalytic cracking system with a "fluidized bed" possessing a narrow-dispersed catalyst, as well as intensifying catalytic cracking of petroleum feedstocks.

Academicians V.S. Aliyev and M.I. Rustamov developed and implemented advanced, highly efficient catalytic cracking systems in Azerbaijan. They introduced a new catalytic cracking system with a "half-direct flow" and applied a reactor with an elevated catalyst flow in its first stage. The gas dynamics, technological, and thermal characteristics of these half-direct flow and two-stage catalytic cracking systems were thoroughly studied by the authors.

For the purpose of obtaining mono olefins, they worked on the catalytic dehydrogenation process of C_4-C_5 paraffin hydrocarbons for the first time worldwide using the K-5 narrow-dispersed catalyst in a fluidized bed. This process significantly reduced the production of divinyl from synthetic rubber by about 35% relative to its yeast value and reduced capital investment in plant construction by 40-50%.

The industrial application of this process yielded significant economic benefits amounting to millions of manats annually. Moreover, this process was implemented in synthetic rubber plants in various locations including Sumgayit, Sterlitamak, Kuibyshev, Omsk, and Romania during the former Soviet Union period.

Under the leadership of Academician V.S. Aliyev, these valuable research findings and the technological processes developed based on them enabled the creation of a solid material base for producing high-quality motor fuels. His research also contributed to increasing the reserves of petroleum residues and heavy oil fractions in addition to distillate petroleum feedstocks (Aliev, Indyukov, Efimova, Gonjarov, Sidorvuk, 1962: 5-11, 30-41).

Academician M.I. Rustamov, on the other hand, was one of the first researchers in Azerbaijan to model and optimize petroleum refining processes mathematically. He developed deterministic mathematical models for catalytic cracking processes of crude oil, fuel oil, and vacuum distillation products, solving the optimization problem of the process under non-stationary conditions and designing control schemes for its operation.

The research conducted under Academician M.I. Rustamov's direct supervision laid the foundation for theoretical and experimental studies in the field of catalytic cracking processes using finely dispersed catalysts. His works were fundamental in the development of advanced technological systems for catalytic cracking of various petroleum feedstocks, including dehydrogenation of butane to butylenes and conversion of o-xylene to phthalic anhydride.

His catalyst development for "direct flow" and "half-direct flow" lines, along with the application of various modified reactors, significantly enhanced the efficiency of reaction apparatus in catalytic cracking by 8-10 times when applied in a fluidized bed. His contributions also introduced concepts such as "activity index," "fine dispersed particles," critical flow cross-section, and the concept of "half-direct flow" to the field of technology (Rustamov, 2006).

Academician M.I. Rustamov played a leading role in the industrial implementation of significant scientific research into efficient and original petroleum refining and petrochemical processes in our republic. These processes were not only applied in our country but also extensively implemented in various cities of the former Soviet Union, as well as in Romania, Poland, and Bulgaria.

During the late 20th century, the global demand for automotive gasoline and the improvement of its quality were pressing issues, which were addressed in the scientific research of our academics, including Academician M.I. Rustamov and Professor A.J. Huseynova. Specifically, they achieved the production of AI-93 automotive gasoline through catalytic cracking processes for the first time, and industrial-type catalytic cracking units (I-B complexes) were designed and implemented at the current "Azneftyanacag" IB. (Rustamov, Aliev, Qusenova, Akimov, 1979).

Acad. M.I. Rustamov and E.M. Seyidrzayeva applied the legal compliance of various heavy (Kudron, mazut) petroleum fractions' catalytic cracking with the participation of activators and passivators. Complex schemes were developed and prepared for their industrial application (Seid-Rzaeva, Kapustin, Khansultanov, Yunis-Miax, 1990).

Furthermore, scientific research was conducted by M.I. Rustamov, G.T. Farhadova, and in the direction of destructive hydroisomerization and destructive isomerization processes aimed at obtaining small-molecule C_4-C_5 hydrocarbons. Their scientific achievements were applied using the Q-43-107 catalytic cracking complex (Rustamov, Aliev, 1980; Ismayılova, 2008: 52-56).

The development of destructive isomerization opens up new aspects of catalytic cracking. Unlike previous purposes of catalytic cracking, these processes aim not only to produce automotive gasoline but also to initiate the petroleum-chemical complex as a starting process, providing for the production of small-molecule isoparaffin and isoolefin hydrocarbons.

Patents from leading countries such as the USA, UK, France, Canada, AFR, and Japan have been obtained for the destructive hydroisomerization process involving the newly synthesized nickel-aluminosilicate catalyst (Rustamova, 2000).

Conclusion

As a result of the catalytic work conducted at the end of the 20th century, it is noteworthy to mention the surface characteristics of zeolite-based catalysts, coking, and the application of the mutual relationship between coking and its effect on the selectivity and activity of the catalytic cracking process.

The characteristics of the conducted research are such that these legal compatibilities are studied within the first seconds of contact between the catalyst and the feedstock. The results obtained allowed for the modeling of catalyst behavior throughout the reactor length and the regulation of its surface properties. This laid the scientific foundation for the creation of non-steady gasoline emulsion processes on partially coked catalysts in the catalytic cracking process, resulting in the development of the Q-43-107 catalytic cracking complex, which was then put into industrial use (Ismayılova, 2008: 126-127).

Currently, our scientists, alongside leading petroleum experts of the republic, continue work in the economically efficient direction of catalytic cracking processes, aimed at obtaining low

technological stage, perspective fuels and petrochemicals, as well as residue-free petroleum emulsions.

For instance, for the first time, with the participation of ion solutions, it has been discovered that it is possible to achieve synthetic oil composed of hybrid paraffin-naften structures that boast a high molecular weight index (HMWI) of 120 and high boil-off points (204 - 250 ^{0}C). The work, executed under the economic collaboration agreement between Azerbaijan and Ukraine, is recognized as the first project of its kind among the former USSR countries.

Moreover, for the first time, the application of the hypercritical extraction process involving CO_2 in the cleaning of asphalt-tar blends, metals and refined, heavy petroleum fractions has created a technology, processed and created in an environmentally-friendly aspect on hydrocracking (Ismayılova, 2008: 52-56).

The refined heavy petroleum and heavy petroleum fractions meet the most recent requirement and ensure the used catalysts are efficiently consumed.

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Received: 18.05.2024 Accepted: 05.07.2024

ISSN: 2707-1146
e-ISSN: 2709-4189

DOI: https://doi.org/10.36719/2707-1146/46/34-37

Asya Shahverdiyeva
Azerbaijan State Pedagogical University
PhD in chemistry
sahverdiyeva.asya@mail.ru
Nargiz Salamova
Institute of Petrochemical Processes named after
academician Y.H. Mammadaliyev of the Ministry of Science and
Education of the Republic of Azerbaijan
Ph.D in chemistry
e_nargiz@mail.ru

STUDY OF THE OIL DETERGENT AND OIL DISPERSING PROPERTIES OF QUATERNARY AMMONIUM SALTS TREATED WITH HEPTANE ACID WITH TRIETHANOLAMINE

Abstract

At present, the wide application of surfactants in various fields such as detergents, foam and emulsion stabilizers, fluorogens, hydrophobizers, corrosion inhibitors makes their synthesis considered one of the urgent issues. In the article, the results of the study of oil collecting and oil dispersing properties of the quaternary ammonium salt formed by triethanolamine (TEA) of heptanoic acid, which is a monobasic carbonic acid, in distilled, drinking, and seawater contaminated with Balakhani oil are given. The surface activity property of the products of different concentrations of this complex was calculated using a tensiometer, and the element content was calculated using the calculation method. The complex formed by heptanoic acid with TEA shows high surface activity by reducing the surface tension from 71.98 mN/m to 26.3 mN/m at that boundary.

In the quaternary ammonium salt of heptanoic acid with TEA, the mass fraction of carbon is 55.9%, the mass fraction of hydrogen is 10.5%, the mass fraction of oxygen is 28.6%, and the mass fraction of nitrogen is 5%.

The complex of heptanoic acid and TEA exhibits the ability to accumulate oil in seawater, both in the pure and 5% percent form of the reagent.

Solutions of various concentrations of the complex formed by heptanoic acid with triethanolamine are well soluble in ethyl and isopropyl alcohols.

Keywords: *oil accumulation, oil dispersion, surface tension, surfactant, carbonic acid*

Introduction

Currently, like other water basins of the world, the pollution of the reservoir of the Caspian Sea and the related deterioration of the ecological situation here are considered urgent issues. Examples of sources of pollution of this sea include tankers carrying oil, and accidents during oil extraction and transportation.

Oil spills degrade water quality and disrupt the balanced relationship of the upper water layers with the atmosphere, leading to a disruption of oxygen to living organisms.

Oil-based films that reflect the sun's rays prevent the energy from being absorbed by the water. The removal of such spots is especially necessary for the life of marine inhabitants, because more than a hundred species of fish, 95% of the world's sturgeon population live in the Caspian Sea.

Surfactants (SAMs) used to remove thin layers of oil from the water surface are divided into oil dispersants and oil collectors (Asadov, Ahmadova, Rahimov, Mammadova, 2011: 1012–1017; Asadov, Nasibova, Poladova, Rahimov, Asadova, 2012. 16: 175–178; Asadov, Tantawy, Zarbaliyeva, Rahimov, 2012: 2; Asadov, Akhmedova, Agazadeh, Nasibova, Zarbalieva, Bagirova, Ragimov, 2012, 1916–1927; *Asadov, Salamova*, Eyyubova, Yolchuyeva, 2020, 388-398; Asadov,

Rahimov, Salamova, 2012, 505-511; Asadov, Tantawy, Zarbaliyeva, Rahimov, 2012, 199–200; Asadov, Tantawy, Zarbaliyeva, Rahimov, Ahmadova, 2012, 136–145; Asadov, Tantawy, Zarbaliyeva, Rahimov, 2012: 621–630; Asadov, Tantawy, Zarbaliyeva, Rahimov, 2013: 261–267; Asadov,Tantawy, Azizov, Zarbaliyeva, Rahimov, 2013: 13–23; Asadov, Zarbaliyeva, Rahimov, Salamova, Eyyubova, Ahmadova, Asadova, 2014: 205–214).

The presented article is dedicated to the study of the oil-collecting and oil-dispersing properties of the complex formed by heptanoic acid with TEA.

The surface activity of substances was determined at the air-water interface using a KSV Sigma 702 tensiometer (Finland) with a Du Nui ring.

Methodology of the Experiment

Heptanoic acid is insoluble in water, relative molecular mass 130.2 g/mol, an oily, colorless liquid with a general formula of $C_6H_{13}COOH$, boiling point 223°C, sparingly soluble in water but well soluble in ethanol, has an unpleasant oily odor. is a saturated monobasic carbonic acid.

Triethanolamine (TEA) is a colorless, transparent, ammoniacal weak base with a molar mass of 149.19 mol/g.

Conduct of Research

The reaction between heptanoic acid and TEA was carried out under laboratory conditions in a 1:1 molar ratio at room temperature with vigorous stirring.

The scheme of the reaction is as follows:

$C_6H_{13}COOH + N(C_2H_4OH)_3 \rightarrow$

$[C_6H_{13}COO^- N^+ H(C_2H_4OH)_3]$

The quaternary ammonium salt obtained based on heptanoic acid and TEA has a relative molecular mass of 279.4 g/mol, and solutions of 0.75% and 0.1% form colloidal solutions in water, dissolving well in ethyl and isopropyl alcohols.

According to the results of the element composition research by calculation method, the mass share of carbon in the quaternary ammonium salt of heptanoic acid with TEA is 55.9%, the mass share of hydrogen is 10.5%, the mass share of oxygen is 28.6%, and the mass share of nitrogen is 5%.

Results and their discussions

The surface activity property of the complex formed by heptanoic acid with TEA was determined using a tensiometer at the water-air interface at a temperature of 21°C (Table 1).

Based on the surface tension values measured by the tensiometer, surface tension isotherms were constructed in the γ-lnC coordinate (Figure 1).

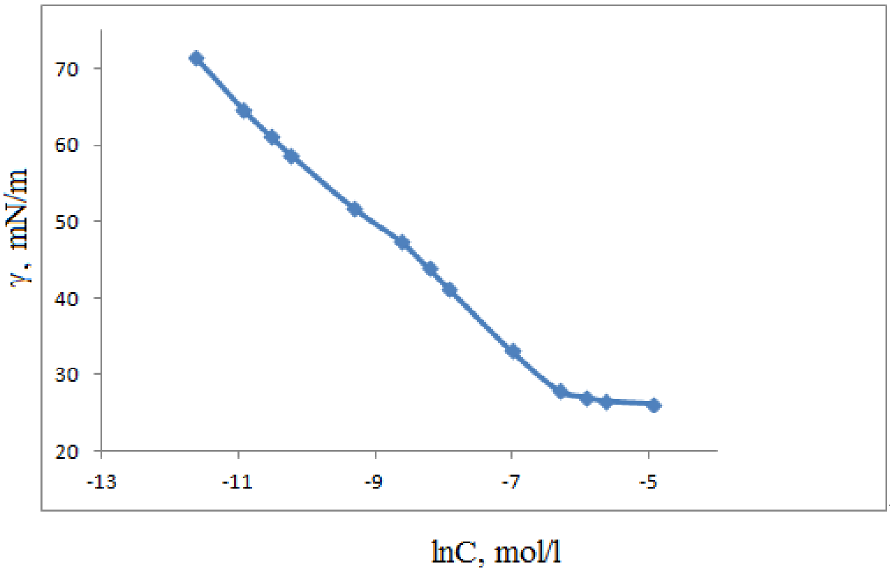


Figure 1 – Surface tension isotherms of salts of heptanoic acid with TEA

NATURE AND SCIENCE International Online Scientific Journal. 2024 / Volume: 6 Issue: 7 / 34-37
ISSN: 2707-1146
e-ISSN: 2709-4189

Based on this picture, the dγ/dlnC value was determined graphically. The surface tension at the water-air boundary in a non-reagent environment is equal to 72.5 $mN \cdot m^{-1}$. The stabilization of the surface tension values of the salt formed by heptanoic acid with TEA occurs at 26.7 $mN \cdot m^{-1}$, respectively. Table 1 lists the colloid-chemical parameters of the synthesized non-ionic SAMs.

Table 1 - Colloid-chemical parameters of salts of heptanoic acid formed with TEA

KMQ×10^{-4}, mol·dm^{-3}	Γ_{max} ×10^{-10}, mol·sm^{-2}	A_{min}×10^{-2}, nm^2	γ_{KMQ}, $mN \cdot m^{-1}$	π_{KMQ}, $mN \cdot m^{-1}$	pC_{20}	ΔG_{mis}, kC/mol^{-1}	ΔG_{ad}, kC/mol^{-1}
3.58	1.93	88.18	26.7	45.8	4.06	-23.6	-47.4

Understanding the processes of micelle formation and adsorption is important to explain the effects of structural and environmental changes.

Note: KMQ is the critical micelle formation density, γ_{KMQ} is the surface tension of the solution during KMQ, Γmax is the maximum adsorption, Amin is the minimum surface area of the polar group, γ_{KMQ} – KMQ is the surface pressure or efficiency, pC_{20} is the efficiency value, ΔG_{mis} is the enthalpy change during micelle formation. , ΔG_{ad} is the enthalpy change during the adsorption process.

Conclusion

The complex formed by heptanoic acid with TEA shows high surface activity by reducing the surface tension from 71.98 mN/m to 26.3 mN/m at that boundary.

The complexes formed by heptanoic acid with TEA were studied as an oil collector and oil dispersant in cleaning the water surface clouded with an oil layer with a thickness of 0.17 nm. The effectiveness of this reagent was studied in the laboratory on waters with different degrees of mineralization using the Balakhani light oil sample. The reagent was used both in its pure form and in the form of a 5% aqueous solution. The reduction of the area of the initial oil layer due to the penetration of the reagent into oil-contaminated waters determines its effectiveness. The oil accumulation coefficient is a quantity that characterizes this effect. K is calculated as the ratio of the initial area of the oil layer to the area of the oil spot formed by the effect of the reagent.

Table 3 – Research results of the oil collection and oil dispersing ability of the TEA complex of heptanoic acid (Balakhani oil; thickness 0.17 mm)

The case of giving the reagent to the surface of the oil	Distilled water		drinkable water		Sea water	
	τ, saat	K(K_D,%)	τ, saat	K(K_D,%)	τ, saat	K(K_D,%)
Undiluted product	0-24 48-72 72-96	Dispersed	0-24 48-72 72-96	Dispersed	0-24 48-72 72-96	Dispersed
5% aqueous dispersion	0-24 48-72 72-96	4 Dispersed	0-24 48-72 72-96	5 Dispersed	0-24 48-72 72-96	Dispersed

As can be seen from Table 3, the complex of Heptanoic acid and TEA exhibits the ability to

accumulate oil in seawater for both application forms of the reagent.

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Received: 11.05.2024 Accepted: 02.07.2024

DOI: https://doi.org/10.36719/2707-1146/46/38-41

Nizami Akbarov
Azerbaijan State Pedagogical University
adpu-kimya@mail.ru
ORCID ID: 0009-0005-4611-8754
Kamala Iskandarova
Azerbaijan State Pedagogical University
kemaleisva@mail.ru

INTRA-DISCIPLINARY AND INTER-DISCIPLINARY INTEGRATION IN THE TEACHING OF THE LANGUAGE OF CHEMISTRY

Abstract

In this article, the intra- and interdisciplinary integration of chemistry language teaching is discussed in order to achieve quality education in the teaching of chemistry. It was noted that quality education in the teaching of chemistry begins with intra-subject and interdisciplinary integration, quality teaching of subjects in the teaching of chemical language. The application of chemical language in education and the correct and purposeful use of modern teaching methods have a positive effect on the mastery of chemistry.

Keywords: *chemical language, interdisciplinary integration, interdisciplinary integration education, teaching, training, subjects, teacher, student, quality education, school, university, learning, reading*

Introduction

Chemical science – since it is a natural science, it develops closely with other precise and natural sciences, in particular, mathematics, biology, geology, physics, ecology, etc. Until the 18th century that the great Russian scientist V. Lomonosov said mathematics is the eye of chemistry and physics (Guliyev, 2014: 38-45).

Many changes in nature – the formation of new substances, the transformation of which they roam in living organisms, photosynthesis, assimilation-dissimulation, and otherbiochemicall processes are chemical phenomena. As the chemistry of these processes is studied, it becomes easier to understand the nature of all biological processes that occur in the body. Therefore, chemical science, in close contact with other natural sciences, is developing faster and expanding its limits day by day (Gurbanov and et.al, 2014: 64-72; Akanbaeva, 2014: 134-135).

At present, new subject curriculums in secondary schools are based on the principles of personality, consequence, and urgency, as well as integrativity. The teaching process requires special knowledge and skills for teachers to use in place of integration. The term integration is used in most fields, and there are many approaches about it that are essentially the same, different in content. Integration is derived from the Latin words "integratio", "integrator", "integrations", which means restoration, whole, whole, complete, unified.

From the given meanings, it is necessary to have integrity and integrity in every field and act accordingly. The integration is to form an integrated and indivisible image of the world in the thinking of students within a given educational system, to establish and systematize structural relationships between all content components of the training, with the aimof guiding them towards growth and self-development (Akbarov, Hasanli, 2022: 9-18).

Integration improves the learning process and serves to deepen interaction and dependence between disciplines. The use of the term integration in its broadest sense began at the end of the twentieth century. However, since the foundation of life, society itself has evolved and formed in relation to the countries of the world, not in isolation in all processes. One of these connections is

ISSN: 2707-1146
e-ISSN: 2709-4189

the field of study. In this regard, along with other fields, there has been a need in education to approach this relationship on an integrated basis (Aliyev, 2006:70-88).

One characteristic of subject curriculums currently practiced in secondary schools is their integrated nature. The chemistry curriculum also provides integration of content lines such as "matter and material world," "chemical phenomena," "experiment and modeling," and "chemistry and life." The knowledge components of the standards provided on those content lines are linked to the following lines of action (Aliyev, 2007:42-56):

1. Naming Substance
2. Determination
3. Compilation
4. Characterization
5. Troubleshooting
6. Performing chemical experiments
7. Solve the case and exercises, chemical calculations
8. Communicating and connecting
9. Submission Outlined action lines ensure the process of mastering content standards.

An integrative curriculum enables teachers and students to: - approach issues globally; - connect concepts (concepts); - connect subjects and topics; - use different resources at the same time, etc. An interdisciplinary curriculum phrase is often used synonymously with an integrated curriculum. Components of the integrative curriculum include the following (Alizadeh, 200l: 12-16):

- Experiential integration – experiences deepen and broaden existing insights.
- Social integration – provides an opportunity for students to share their passion through a democratic learning process.
- Knowledge integration – students take their previous knowledge, skills and skills as the basis for new studies.

Integration of education means the formation of a global way of thinking, solidarity, and responsibility for students using the connections that are naturally present between them in the teaching of different disciplines. Integration is Latin for "integrio", meaning "restoration, completion". Integration is the skillful and efficient use of intra- and interdisciplinary relations to enrich the lesson material in the teaching process (Ilyasov, 20l8: 47-49).

Providing intra-disciplinary and interdisciplinary integration in the teaching process according to educators is an essential prerequisite for easier mastering of knowledge and skills by students, establishing interesting and contentious lessons, and developing research and research trends in students. The experts cite the reasons for the need to create integrative curricula as follows (Mehrabov, 2005:24-29):

- Any form of learning can be used to teach integrated topics and concepts.
- Loaded with training material, repeated learning of the same concept through different disciplines is avoided.
-Access to different stages of training (vertical integration) and linking concepts (horizontal integration). An integrative curriculum provides an opportunity to put in place important research questions and conduct extensive research around them. When an integrative curriculum is applied, the purpose of education here includes not only learning and knowing about events and manifestations, but also using acquired knowledge, skills, and values in different situations, improving research, understanding. Interdisciplinary curricula address issues that limit the ability of the subject and contribute to the study of a wide range of areas by linking different sides of the subject curricula. All reforms about integrated and interdisciplinary curricula are thus grouped; merging disciplines, increasing focus on creative activity, use of textbook sources, gutter relationships between concepts, changing schedules, and changing groupings of students (Weisova, 2004: 38-42).

Level of interdisciplinary integration. Special importance is given to interdisciplinary integration during the organization of integrated learning. This level of integration involves the use

of concepts and methods related to one discipline in the study of another discipline, with the synthesis of shared concepts, knowledge, and skills covered by several disciplines. Interdisciplinary integration serves to expand learning materials with content at the expense of the capabilities of other disciplines, and to provide in-depth analysis and summarization of issues. This process ensures that the same skill is improved through individual disciplines and provides an opportunity to enhance the learning process. Methodical literature talks about special skills called interdisciplinary skills. Interdisciplinary skills occur in relation to the content of several disciplines and are useful for real life situations. Because they are natural connector to integrate the subjects (Polat, 2002: 9-l7).

Interdisciplinary skills require students to perform complex activities. These skills include teaching and learning, critical approach, efficient communication, problem-solving, integrations management, etc. Here's an example of one. Teachers provide generalized knowledge of the essence and content in the classroom, depending on their expertise and skills, in the context of natural connections to students in close proximity to their subjects (relatives). However, what is new in our minds is that as the creation of these connections is considered as a principle and one of the content components in the subject curriculum in the name of integration, teachers should consider this as a state requirement in the course plan.

Teachers who teach the subject use knowledge related to other natural sciences that are directly related to chemistry in this process. In this regard, there is a need for a high degree of use of integration in the teaching of chemistry. Because the substances and combinations of chemistry studied are related to the world around them, it is important to integrate them with the development of students' ecological knowledge. This issue is reflected in the standards of the “Chemistry and Life” content line of the subject curriculum. Therefore, it is important to integrate environmental education, environmental knowledge and skills into the study and chemistry lessons on the merits and content of literature materials. In order for students to gain a deep understanding of the ecological issues they are constantly encountering, the reasons that create them should be investigated by integrating chemistry with knowledge. The integration of ecological knowledge in the teaching of chemistry has great educational value. In chemistry classes, the need to connect not only with the natural sciences but also with technical disciplines elevates the integrability of the subject to a higher level, elevates its leading role, enables effective use of different learning methods, requires more co-connections with the sciences

Interdisciplinary integration as a pedagogical problem. The political and theoretical level of education is determined by the social requirements of society and the science and technical progress. In this regard, interdisciplinary connectivity emerges as a most pressing pedagogical problem. This issue is closely related to the content and structure of education. Therefore, this should be reflected in training methods, forms, and tools. Interdisciplinary communication helps students build their knowledge, create a full picture of the real world, and form a mutual dialectic of events. The correct solution to the problems of coordination and integration of educational content is also closely related directly to interdisciplinary communication.

Coordination, when designing a curriculum of individual subjects, deals with agreements and mapping to eliminate conflicts in the teaching and learning of the same subject in different subjects. Integration, however, refers to one-quarter of the aspects of that event that are considered in individual natural sciences in order to provide a complete picture of a particular natural phenomenon being taught. Apparently both are interdisciplinary (Avidov-Ungar, 20l8: l83 -l9l).

Clarifying the interdisciplinary relationship to the end provides optimal conditions for student learning and development. Therefore, the interdisciplinary relationship is viewed as an integral part of the training. The setting of the structure of the subject is also related to the solution of this problem, where students receive systematic and solid knowledge about the fundamentals of science. The study of the relationship between physical, chemical and biological sciences is especially important. Because, a number of advanced scientific ideas, such as molecular-kinetic theory, electronic theory, electrolysis, and some other concepts that form the main content of these

sciences, have firmly established themselves in the natural sciences. A number of their key issues are explained on the basis of these concepts.

Conclusion

Automation and mechanization of production processes, extensive use of the working principle of living mechanisms for the future progress of the technique, and so on, require highly qualified personnel who can handle new techniques. That is why secondary schools are most important for their students to gain a wide range of knowledge and skills that can keep up with the techniques. With this in mind, it is necessary to ensure that teachers of physics, chemistry, biology, and other natural sciences communicate closely, consult, and determine the scope of application of theoretical knowledge intended to be taught, to achieve a good understanding of the educational material by students and to activate learning methods. The work of advanced teachers shows that the physics class is more efficient when the material taught in that lesson is linked to phenomena in the environment, tied to the facts of living nature, and considered as the theoretical basis for the relevant technical devices.

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Received: 15.05.2024 Accepted: 22.06.2024

BIOLOGICAL SCIENCES AND AGRARIAN SCIENCES

DOI: https://doi.org/10.36719/2707-1146/46/42-46

Raifa Salmanova
Nakhchival State University
PhD in biology
raifa_salmanova@mail.ru

SOME GREENGAGE AND PLUM VARIETIES COMMON IN THE TERRITORY OF THE NAKHCHIVAN AUTONOMOUS REPUBLIC AND THEIR BIOMORPHOLOGICAL PROPERTIES

Abstract

The selection of fruit and fruit breeds of each zone is one of the most efficient means of increasing the yields of varieties in meeting the population's demand for food crops, including fruit and fruit crops. Each zone of our republic with rich fruit varieties requires ways to increase fruit production, lower crop yields, use land more efficiently, and improve labour productivity and other economic activities. Because of its importance within dandelion fruit plants, the greengage plant is one of the special places. For quick productivity, yielding every year, tolerance to diseases and pests opens up plenty of opportunities for cultivating the greengage in various fields.

Keywords: Plum,greengage, prunus,dandelion, blue plum, phenology

Introduction

A number of local and incoming fruit crops are cultivated on farms in regions and zones of Azerbaijan such as Guba-Khachmaz, Shirvan, Lankaran-Astara, Ganja, Gazakh, Shaki-Zagatala, Nakhchivan and others. Sometimes, without learning, fruit crops are cultivated without being identified for local conditions. Specifically, in recent times, a number of shooty, shriveled fruit plants have been growing varieties that are not at all valuable to local conditions. In this respect, the local fruit varieties of our republic are also compressed and eliminated. Our main goal was to study greengage and plum varieties distributed in the autonomous republic, study the biology of flowering and harvesting, and offer some suggestions.

Material and methods

Azerbaijan is one of the first homeland of greengage Native greengage varieties cultivated on farms still retain their prominence. The late professor A.J.Rajabli, in his monograph "Fruit crops of Azerbaijan" (1966), elaborates on the varieties of greengage in Azerbaijan. For our republic, which is considered the home of the greengage, she interprets a number of valuable greengage varieties (Sabran, Spring, Summer and Autumn sort), Arash greengage (Istambul) Goyja, etc.

Dominance in classification, based on systematic principles (Safarov, Jalilov, Asadov, 1981: 123; Shennikov, Vvedeniye's geobotanic, Shennikov, 1975: 447; Yroshenko, 1967: 27-31; Grosgeym 1946: 671) and the references of other researchers were used.

The greengage plant is produced fresh and processed at the same time. Sugar (14%), acids (4 %), pectin (15%), a number of vitamins B, E, P, etc. are necessary for the human body (Ibrahimov, 1981: 117-122).

Greengage is a fruit plant that has also gained a reputation as the world's pomology. This valuable plant is cultivated in vast fields in Krasnador, Moldova, Germany, Turkey, and Italy. Azerbaijan is one of the first homelands of greengage (Abutalibov, Hajiyev, Isayev, Safarov, Khalilov, 1975: 213-229). Native greengage varieties cultivated on farms still retain their prominence. In recent times (1986-2022), extensive research work has been carried out on the biological farming properties, disease and pest resistance, planting schemes, etc. of a variety of native and introduced varieties of greengages. (Talibov, Ibrahimov, 2008: 126-133).

ISSN: 2707-1146
e-ISSN: 2709-4189

The greengage and plum are included in the Rosaceae family of the Rosales line of the Angiosperms in the Plants' World. These plants are concentrated within the genus Prunus-plum.

A tree or shrub that is not very large is an umbrella or pyramid-shaped umbrella. The stem is brown, thorny or thornless. The leaves are rounded, with round ellipses, eggshells, reversed eggshells, and prickly. The flowers are together or single one by one. (Gladkova, 1989: 104-113). It opens in spring before leafing or at a time with leaves. The casseroles and petals are 5, the males are numerous. The ovary is unilocular and bilocular. The fruit consists of smooth-surface, single-stemmed, cartilage and juicy meat. The cartilage is oval, and tapered to the sides. The leaves of the plum tree and bush fall in autumn. Buds are usually thornless, sometimes thorny. (Asgarov, 2005: 247).

Planted and grown varieties of this plant occupy a great place in the country's horticultural farm. Plum species require nutritious and humid soil. İt sprouts from the root and maintains its ability to sprout until it gets old.

Five sorts of plum species that are common in countries with good climates occur in the Caucasus and Azerbaijan, of which only two sorts are planted and grown. Ibrahimov, 2001: 68).

Private farms did not have separate orchards on any public farm, with the exception of mixed orchards on individual farms, when people selectors upgraded valuable greengages and expanded their areas.

The most valuable greengage varieties, which are unique in stone fruits, are biodegradable to farms if their fields are expanded, and are recommended to be planted and cultivated on public farms. (Ibrahimov, Talibov, 2000: 12-23; Isgandarov, Rosa, 1999: 92- 95).

Species and varieties of greengage (Prunus) plant common in Nakhchivan AR

1. Genus: Armeniaco – prunus Cinovskis greengage-apricot

1 (1) *A. dasycarpa (Ehrh.) Cinovskis – Hairy greengage-apricot

2. Genus: Prunus L. – greengage

2 (1) P. diverata Ledeb. – Plum- greengage

3 (2) *P. spinosa L. –Blue plum

3 (3) *P. nachichevanica Kudr. – Nakhchivan plum.

3 (4) *P. domestica L. – Home p.

Gender 1. Greengage-apricot - Armeniaco–Prunus Ginovskis. A tree up to 6 m high with a dense umbrella and a flat stem. The branches are close to the soil and the trunk is 25-55 cm in diameter. The stem of old trees is dark or grayish-brown, and the stem in young cranes is covered with a lightly colored coral, which is reddish-brown; the leaves are simple eggshells, and the shoots are girdle-shaped. The hairs are white, and the large petals are round. The males are white and number 25-40. The female is fluffy and the ovule is yellow. Fruits range in color from light yellow to reddish-orange. It has pits in it. The size and shape of the trunk are different. The trunk adheres to the fleshy part of the fruit or is easy to separate from. The leaf blooms ahead, and the flowering takes 7-10 days. It spread among the shrubs and in the forest of Arafsa (Treasure-Valley) in Julfa district, Batabat, Bichanak of Shahbuz district, Khurs of Ordubad district, villages of Nurgut. This genus has one species in the Autonomous Republic.

Hairy greengage - apricot - A. Dasycarpa (Ehrh.) Cinovskis. The trees aren't too tall. The flowers are white and large. The petals are round. The female is fluffy and the ovule is yellow. It blooms and produces seeds in April-May. Culturally cultivated. It is found in the Ordubad district in its wild form. The fruits are preserved and jammed. Homeland – Central Asia. Nutritious food. It's mesophyte.

Gender 2. Greengage - Prunus L. An umbrella that is not large is a tree or shrub. The stem is brown, with or without thorns. The leaves are round, elliptical and rounded. The flowers are opened before leafing or at the same time as the leaf. The leaves and petals are 5. There are many males. The ovary can be unilocular or bilocular. The fruit is a single-seeded with juicy meat. The speck is oval and tapered.

Greegage plum - P. Wallicata Ledeb. A tree with a wide-shaped umbrella that is 10- to15m high is a shrub in low cases. The branches are thorny. Tumours are brown in color and are 1-1.5 m long. The flower shoots are cone-shaped and egg-shaped. The leaves are bare at the top and hairy at the bottom along the middle vein. The flowers are opened before the foliage. The flower stalk is bare and 1-2.2 cm long. The tips of the leaves are prickly, the petals are 5-10 mm long and white. The egg and its column are bare. The fruit is yellow purple and red and is 3 cm in diameter. The stone is oval-shaped. It blooms in March-April and bears fruit in July-August. It is found around villages of Guanchay, Vanand, Nailnys of Ordubad region, Abragunus of Julfa district, Kirna, Goydara, Alinja, Karabaghs of Kenanli region, Vaykhir, Khalil of Babak region, Karababa, Ashus of Shahbuz region and others, in forests, shrublands, field, mountain slopes, river valleys. It's mesophyte. The eastern seaboard is a type of geographical range.

Nakhchivan Plum - P. nachichevanica Kudr. 3 to 5 m tall trees. The fruit is pinkish-green or light red. It's round, it's sharp, it has a cut out base. Culturally cultivated. It is found in Iran in the wild. It's mesophyte. It is a valuable food plant.

Plum - P. spinosa L. A tree with a thorny branch that is 3-4 m high. The young scions are yellowish-brown and then bare and shiny. The cover of the plant is dark grayish-brown and has a faint layer. The sprouts are 1-2 mm long and egg-shaped. The leaves are elliptical, undersea egg-laying, the seat of which is wedge-shaped, edge-shaped, and rounded sawdust. The young leaves are short and the mature leaves are bare. Flowers are located one by one and open before leafing. The flower stems are short and bare or hairy. The edge of the cupule is ciliate and the petals are white. The fruit is found on straight standing stems, black and 1-1.5 cm in diameter. It blooms and produces fruit in March and August. The Shahbuz region is common in forests, forest tales, forest areas around the villages of Beachcake, Agbulag, Khurs of Ordubad district, Alahi, Kotam, Milakh of Julfa district, Arafsa, etc. It's mesophyte. It is a geographical range from Europe to the Mediterranean Sea.

Domestic plum - P. domestica L. Trees that are 10- to12m high with wide or low-lying umbrella trees. The branches are unstructured or slightly unstructured. Young hairs are reddish-brown or greenish-brown and bare. The leaves are bare on the base, hairy on the bottom, and elliptical. The petals are9-11 mm long and are white. Fruits come in different shapes and both sides are tapered. The seed is coarse or slightly rugged, with a wide oval. From April to May, flowers give seeds. It is spread around the villages of Pusyan, Khans, Aralik, Demirchi of Sharur District, Channab, Bilav, Behrud of Ordubad District, Benaniyar of Julfa District, Khalkhal, Kultapa, Vaykhir etc. of Babak District. It is a valuable food plant. It's mesophyte. Private farms did not have separate orchards on any public farm, with the exception of mixed orchards on individual farms, when people selectors upgraded valuable greengages and expanded their areas. The most valuable greengage varieties, which are unique in stone fruits, are biodegradable to farms if their fields are expanded, and are recommended to be planted and cultivated on public farms.

Spring Savory. An ancient species of the Nakhchivan AR, common in Ordubad district. The tree is medium-high and low in height. The leaf is in a special shape. The fruit is crisp, oval round, greenish-yellow, with a clear pink cheek. One fruit weighs 28g. The fruit is solid, wet, it tastes soury sweet. The fruit grows on the first day of June. It's a productive variety. 60-80 kg of product is produced from a tree. Suitable for mountain zone.

Goyja. Its name is *"goyja" (bluish color)* because the fruit is eaten when it is blue. Nakhchivan AR is one of the ancient varieties of the fruit. The tree reaches a height of 5-7 meters. The fruit is oval in a round oval shape with a tapered top. The fruit is solid, greenish, juicy. It begins to ripen on the second day of May and lasts until mid-June. Productive varieties, 70-90 kg of product are produced from each tree. It can be cultivated extensively in the flat zone of Babek, Sharur.

Summer Savory. It is one of the oldest indigenous alchemical varieties of the autonomous republic, especially in the district of Ordubad, which may be more widespread. The tree is tall and shaped like a ball. The fruit is 40-42 g. The fruit is juicy, and fragrant, and the skin is thin. The fruit

grows on the twelfth of August. Each tree yields 50-60 kg. Suitable for drying and shipping to remote locations.

Autumn Savory. It is an ancient local variety. The tree reaches a height of 4 to5 m . The fruit is oval round, bright yellow. The fruit is juicy, brittle, and tastes sour. The seed is not separated from the fruit. It begins to ripen in early September. Priced for drying and compote.

Rajabi. The tree is medium in size with a height of 3-4 meters. The umbrella is shaped like a pyramid and its branches are scarce around it. The fruit is round, light-yellow, and the bottom is reddish pink. The fruit is juicy, sweet, and flavorful. It's a productive variety. 60-80 kg of product is produced from a tree. The fruit has begun to ripen on the second of July and continues until early August.

Red plum (greengage). An ancient variety of Nakhchivan AR, it can be widely cultivated in the low and mountainous zones of Ordubad, Julfa, Babak, and Sharur. The tree is 5-6 m tall and has a small umbrella and densely leafed. The fruit is a long elliptical with a dark red. The fruit is red, juicy, and soury. The fruit grows at the beginning of September, is a fertile variety, and 80-100 kg of fruit is produced from each tree. It is tolerable to ship to remote locations.

Tabarza. A local variety belonging to Ordubad region, it is advisable to cultivate widely in the low and mountainous zones of the autonomous republic. The tree is tall, the umbrella of the fruit is small, the fruit is juicy and soft, and the fruit grows on the second day of June. A medium-growth variety, 40-50 kg of each tree is produced. Good for eating and compote.

Movuj plum (greengage). We find this in private farms of the Sharur region. Can be cultivated on public farms. The tree is ornate, with an umbrella ball, and branches sparse. The fruit is reddish pink on the inside, light purple, with a ray of sunshine. The flesh is lush, dark purple, tastes sweet, and is short of fruit stalks. The fruit grows on the first of June and resembles dried seasoning 10-15 days after skinning. Valuable jam and compote are readily available. In order to produce abundant and high yields from the weed tree, it is important to seriously fight bodily injury that lowers their productivity.

Flowering phase course of greengage varieties

The yield of each plant depends more on its bloom. It is of practical importance that the varieties are properly selected and placed in the garden, the complex organization of agrotechnical operations, and the proper study of the flowering time of each variety. In fruit and fruit crops, flower shoots do not open simultaneously, even within the same plant. Because of this, they take time from the beginning to the end of flowering in several stages.

The fruit associated with flowering is important in the realization of the harvest, affecting their harvest during the ripening period and at different times in varieties. Given the importance of the mentioned phenological phases in the life of these varieties, the phenophases for the varieties have been studied and the results are given in table # 1.

Periods of passage of phases in greengage varieties

Table 1.

Sorts	Pruning	Beginning of flowering	Massive bloom	Flowering Strength with point	Ripening of fruit	Fruit harvest
Summer Savory	22. III	3. IV	9. IV	4,5	10. VI	14.VI
Autumn savory	28. III	12. IV	19. IV	4	5. IV	10.IX
Arash greengage (Istanbul)	25. III	5. IV	12. IV	4,5	13. VII	16.VII
Goyja	26 III	7. IV	14. IV	4-2	15. VII	19.VII

As interpreted in Table 1, when considering the duration of the phenological phases of greengage varieties, we find that budding, flowering, and fruit ripening differ considerably over the days according to the biological properties of the varieties. From the varieties, the quickest budding **spring** savory variety has begun. So, in the third month, 22. the spring savory began to bud, whereas 28. the autumn savory started in the same month. Other sorts- 25. Arash greengage 3rd month, 26. Goyja started to bud in 3rd month. In flowering, the earliest was 3. the spring savory variety in the 4th month, in the Arash greengage in the 4th month, and in the autumn savory varieties in the 4th month. In the 7. Goycha variety, it was the 4th month. This pattern also significantly influenced the mass flowering phase, fruit ripening, and harvest period. The strongest flowering and fruit setting occurred in the spring savory and Arash greengage (Istanbul plum) varieties.

Conclusion

As a result of this study, it was found that Greengage - apricot - Hairy greengage of the genus Armeniaco-Prunus Ginovskis - apricot - A. Dasycarpa (Ehrh.) Jinovskis is a species of greengage - greengage plum of the genus Prunus L. P. Wallicata Ledeb., Nakhchivan plum - P. nachichevanica Kudr., Goyja Plum - P. spinosa L. and Domestic Plum - P. domestica L. species , Spring savory, Goyja, Summer Savory, Autumn Savory, Rajabi , Red plum (greengage), Tabarza and Movuj greengage varieties are common.

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Received: 12.05.2024 Accepted: 26.06.2024

DOI: https://doi.org/10.36719/2707-1146/46/47-52

Afsana Abdullayeva
Khazar University
PhD student
afsana.abdullayeva@khazar.org

ANALYSIS OF THE ROLE OF MOLECULAR MARKER TECHNOLOGIES IN THE RESEARCH OF GENETIC DIVERSITY OF PLANTS

Abstract

Genetic diversity in plant selection refers to varieties and differences in the genetic composition of plant species. In this article, the types of molecular markers most commonly used in determining genetic diversity in plants are examined and their advantages and application in various research fields are covered. Also, future perspectives on this technology and innovations created by them in plant research will be discussed. The development of PCR-based molecular marker techniques plays an important role in the evolution of plant selection programs. It enables faster and more effective access to information about the genetic characteristics of particular economically valuable plant species. In plant selection, more commonly RAPD, ISSR, SRAP, and AFLP scar, SSR markers are used in assessing the genetic diversity of plants and have some positive properties according to the purpose of the study. The use of these marker techniques ensures a grade and reasonable improvement in the selection of plant species. These technologies help to make progress by distinguishing existing variations more efficiently and efficiently to identify the most desirable forms in selection programs. A significant step toward more effective selection processes, growth in crop cultivation, and protection of genetic diversity.

Keywords: *Molecular markers, PCR, RAPD, ISSR, SSR*

Introduction

Research at the molecular level of plants, along with the development of biotechnology, has made significant progress. Molecular markers in this field are widely applied to the study of the genetic diversity of plants, to the improvement of selection programs, and to the creation of disease-resistant varieties (Smith et al., 2020: 125). Molecular markers allow us to detect differences between the genotypes of plants, targeting very small portions of genetic information (Jones et al., 2018: 101).

The use of molecular markers is more accurate and effective than traditional selection methods. These markers, in particular DNA-based markers (SSR, SNP, AFLP, etc.), are widely used in various genetic analyses. The main purpose of DNA markers is to detect genetic differences between individuals, species, etc. These differences in a given region of the genome are called alleles. The advantage of detecting such differences at the DNA level is that any DNA chain can show allelic differences between two individuals (Gulshan & Mutlu, 2005: 29).

There are two DNA marker techniques available. These are RFLPs based on DNA hybridization, the other, and markers such as RAPD (Random Amplified Polymorphic DNA), AFLP (Amplified Fragment Length Polymorphism), sts (Sequence Tagged Site), SCAR (Sequence Characterized Amplified Region), SSR (Simple Sequence Repeat), and ISSR (Inter Simple Sequence Repeat), which are most commonly used in current cycles (Semagn et.al., 2006: 2542; Gulshan & Mutlu, 2005: 29).

With the use of molecular markers in plants, gene pyramids provide advantages such as creation, selection of recessive genes, gene transfer from wild gene sources, and early selection, thus accelerating the acquisition of new varieties. Molecular marker technology is considered to be complementary and supportive methods for classically breeding methods. Thanks to molecular marker technology and marker-assisted selection technique, successful and reliable results will be possible in a much shorter time compared to classical methods (Jealous et.al., 2015: 10).

1 Material and methods

As study material, the molecular marker techniques most commonly used in plant selection (RFLP, RAPD, AFLP, ISR, SNP, etc.) have been investigated.

1=1 Hybridization-based markers.

RFLP (Restriction Fragment Length Polymorphism) markers were first used to identify DNA sequence polymorphisms for genetic mapping of temperature-sensitive mutations of adenovirus serotypes (Grodzicker et al., 1975: 441). As the first generation of DNA markers, it is one of the most effective methods of mapping the plant genome and has a codominant property. RFLP is among the most commonly used molecular markers based on hybridization and is usually identified by radioactive agents. RFLP markers are molecular markers that work on the basis of cutting down DNA in certain regions of DNA by restriking enzymes and analyzing the lengths of fragments generated to detect genetic variations. This method allows the identification of genetic variations, polymorphisms, especially changes in restriction **.** RFLP markers are highly accurate and reliable. RFLP markers mainly detect polymorphisms in encoding regions, making them more useful for functional genomics research (Acquaah, 2012: 390).

1 - 2 PCR-based markers. Polymerase chain reaction (PCR) is a technology discovered in 1986 that directly amplifies a specific short segment of DNA without the use of a cloning method (Mullis & Faloona, 1986). One of the advanced markers, hybridization-based markers, is more reliable, and in the PCR-based molecular marker system, oligonucleotides called primers, which are 10-25 bp in length, are used (Acquaah, 2012: 390).

RAPD (Random Amplified Polymorphic DNA) markers are a technique that amplifies different regions of DNA using short and random primers. This technique allows to detect variations and polymorphisms in DNA (Williams et.al., 1990: 7214; Welsh & McClelland, 1990: 6532).

RAPD marker technology is distinguished by its economical efficiency, rapidity, and lack of upfront information about the nucleotide sequence of the genome. The RAPD method is used intensively in the study of genetic variation in plants. This is because it is cheaper, simpler, and requires less DNA than other molecular marker methods. At the same time, large quantities of samples are adequate for screening. Due to the use of random primers in RAPD technology, different regions of the genome are amplified and different DNA fragments are obtained (Jealous et. al., 2015: 10).

Regarding the negative characteristics of RAPD markers, it is possible to first mention the dominance characteristic (i.e., homozygous and heterozygous locus cannot be distinguished). Different lab conditions or different PCR machines may cause results to vary, with limited trust. By converting RAPD markers to scar markers, the reliability of genetic markers can be significantly enhanced, as shown in the study of Yu and his collaborators (2000: 413).

SCAR (Sequence Characterized Amplified Region) and sts (Sequence Tagged Site). It is possible to make longer primers (about 22-24 bp) by sequencing the ends of fragments obtained from PCR-based markers. These primers are used in the creation of SCAR markers and have a higher reproductivity than RAPD markers. SCAR markers are made by sequencing the ends of RAPD fragments, which means they are primers designed complementarily to specific DNA fragments obtained through the use of RAPD marker technology. At the same time, sts markers are obtained by sequencing the ends of RFLP fragments. SCAR markers are usually dominant markers, which makes them useful in specific genetic studies (Acquaah, 2012: 397).

The high repetition characteristic of SCAR markers, the codominant nature, as well as the fact that they require little and short time compared to RAPD primers, are some of their advantages. However, initial preparatory work and technical skills are required for their creation and use and to produce repeatable and accurate results (Acquaah, 2012: 397).

SNP (Single Nucleotide Polymorphism) markers are polymorphisms produced by changing one single nucleotide (A, T, C, G) in the genome. These changes are the simplest and most common form of genetic diversity and can affect many biological processes. SNP markers can be located in different parts of the genome and are widely used for genetic analysis at the individual, population,

and species levels. SNPs are the most abundant and widely used molecular markers in the genome. Their occurrence and distribution vary between species. More informative than multiallel markers such as RFLP and microsatellites (Acquaah, 2012: 398).

SNP markers, human genome mapping by various research groups, have been widely used to study genetic diversity (Lander et. al., 2001: 861).

SSR markers (Simple Sequence Repeats) are also known as microsatellites, are codominant, are high in polymorphism, and display multiple alleles, allowing high accuracy of genetic correspondence. It is widely distributed throughout the entire genome and can be applied to a variety of organisms. In genetic mapping research in plants, SSR techniques are commonly used because of their advantages. The results are very repeatable and do not vary from lab to lab. It also enhances its use by giving a codominant marker and making PCR easy (Röder et.al., 1995: 330; Acquaah, 2012: 398).

SSR markers are more accurate than RAPD markers in assessing genetic kinship. SSR markers can detect more polymorphisms among individuals. (Ravi et.al., 2003: 134).

In recent years, many molecular genetics laboratories around the world have successfully used SSR in a variety of plants. The most important drawbacks are that the mutation rate is high, markers are difficult to develop, it is an expensive process that requires a lot of labor, it does not require high-precision laboratory conditions. Alternative marker systems are used to address these challenges, for example the SNP marker can be used to address some of the disadvantages of SSRs. (Acquaah, 2012: 398; Jealous et.al., 2015: 10).

AFLPs (Amplified Fragment Length Polymorphism) are simply RFLPs visualized by selective PCR amplification of DNA restriction fragments (Acquaah, 2012: 390). AFLP markers are a marker system (Vos et.al., 1995: 4409) that works on the basis of DNA interrogation by restriking enzymes, binding of adaptors, amplification of PCR with select primers, and lastly, separation of fragments by electrophoresis. This technique allows us to detect polymorphisms in different regions of the genome and determine genetic diversity.

The AFLP technique has higher reproducibility and polymorphism levels than the RAPD method.

ISSR (Inter-Simple Sequence Repeat) markers are molecular markers generated by amplification of regions between microsatellites in the genome. Microsatellites are short tandem repeat sequences that are common in the genome. ISSR markers use the PCR technique through specific primers, targeting unique sequences around these microsatellites (Zietkiewicz et.al., 1994: 176).

Zietkiewicz and his collaborators (1994) first described the principles and effectiveness of ISSR markers and emphasized the sensitive and highly repeatable nature of this method.

ISSR markers are effective techniques that can be applied to many field crops in determining genetic diversity, phylogenetic research, designing genome maps, and evolutionary biology, making them easier to apply and more reliable because primers are longer (Reddy et al., 2002; Acquaah, 2012: 390).

ISSR is simple and quick to use. Combines the benefits of SSR, AFLP, and RAPD markers. The main disadvantage is that it is dominant (unable to distinguish heterozygous locale) and requires some technical expertise and equipment to perform ISSR analysis. (Acquaah 2012: 397).

Desirable properties of molecular markers:

The application of molecular markers in plant selection and biology is diverse and growing exponentially. Markers desire a variety of features to be useful.

1. High Polymorphism: Markers are required to have high polymorphic properties to distinguish between widely distinguished genotypes.
2. Codominant heredity: Heterozygous and homozygous individuals must have codominant properties to distinguish them.
3. Frequent occurrence and random distribution in the genome: Markers should be frequent in the genome and should be observed in all tissues.

ISSN: 2707-1146
e-ISSN: 2709-4189

4. Selective neutral behavior: Markers should behave selectively and show neutral genetic variants.
5. Easy access and low cost: markers should be easily accessible and the value spent on research goods should be low.
6. High yields and high reproduction: Markers must have a high degree of reproducibility and be capable of transferring between populations and species.
7. Easy and fast analysis: Markers should be suitable for automated processes and analyses should be carried out in a fast manner.
8. Low mutation rate.

(Semang et.al., 2006: 2540; Broadel, 2013: 11-12; Jealous et.al., 2015: 10; Acquaah, 2012: 390).

Conclusions and discussions

Based on the information gathered about the molecular markers, the table below is constructed and shows their pros and cons. However, researchers can select markers that align with their goals (the body they have, laboratory conditions, etc.) according to these characteristics.

Comparison of molecular markers Table 1.

Marker	Being PCR-based	Dominance	Positive aspects	Negative aspects
RFLP	-	Codominant	- Accuracy and reliability -In areas that encode, detects polymorphism - Required among populations transferable	-Very time-consuming -There is a high level of funding - Complicated procedure - Low polymorphism
RAPD	+	Dominant	-Low financial -Quick results and easy to use -Small amounts of DNA enough -High polymorphism	-Limited reliability -Low migration -Difficult to analyze -Low reproduction
AFLP	+	Dominant	-Trustworthy -High repeat-probability - High polymorphism	-Very time-consuming - Goodness high - Methodology compound - Large quantities requires DNA
SSR	+	Codominant	- High polymorphism - High repeatability and time requirement - Multiple alleles - Extensive in genome spread	- High volume of work - High mutation - High-financial
ISSR	+	Dominant	- High polymorphism - Easy to apply, need to use fast - Low financial-Trustworthy	- Technical experience - Difficulty of the primer design

ISSN: 2707-1146
e-ISSN: 2709-4189

SCAR	+	Codominant	- Specificity - Accuracy - Easy analysis	- Compound and time requirement - High quality DNA requirement - Difficulty of the primer design
SNP	+	Codominant	- High polymorphism - Rapid analysis - Low mutation rate - Stable and repeatable	- Time-consuming - High finance

Table 1 shows the advantages and disadvantages of markers in a comparative way, and as can be seen, while there is no optimal marker available that meets all the requirements, researchers can choose the markers that match their own.

Conclusion

Each type of marker has its own unique advantages and disadvantages, and the choice of a particular marker depends on the specific objectives of the study. In order to determine which molecular marker technique is best suited for researching genetic variation in plant species, molecular markers are widely used when compared, as SSR markers offer high polymorphism and reproductivity. ISSR markers, however, combine both the stability of SSRs and the simplicity of RAPD. The RAPD and ISSR are more financially sound. RAPD is alsodistinguished by a hearty and simple analysis process, requiring no special knowledge or equipment. AFLP can be used because of its high marker density and speed.

Consequently, the use of molecular markers in plants is of great importance for genetic studies and selection programs. These technologies play an important role in preserving and enhancing the genetic diversity of plants, improving productivity and disease resilience. Future research and developments, expanding the application of molecular markers, can create new opportunities for agricultural and biotechnology development. In future prospects, molecular markers are expected to be further improved and combined with new technologies. Thanks to modern DNA modification technologies, selectors can create new variations that were previously impossible to achieve. These technologies help to effectively and efficiently distinguish existing variations to identify the most desired forms in breeding programs, thereby aiding in achieving progress.DNA marker technology plays an important role in this process, allowing selectors to make more accurate selections.

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Received: 08.06.2024 Accepted: 03.07.2024

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Signed: 17.07.2024
Format: 60/84, 1/8
Stock issuance: 6,75 ç.v.
Order: 781

It has been published on aem.az.
Adress: Baku city, Matbuat avenue, 529.
"Azerbaijan" publish house, 6th floor.
Tel.: +994 50 209 59 68
+994 55 209 59 68
+994 12 510 63 99
e-mail: zengezurda1868@mail.ru